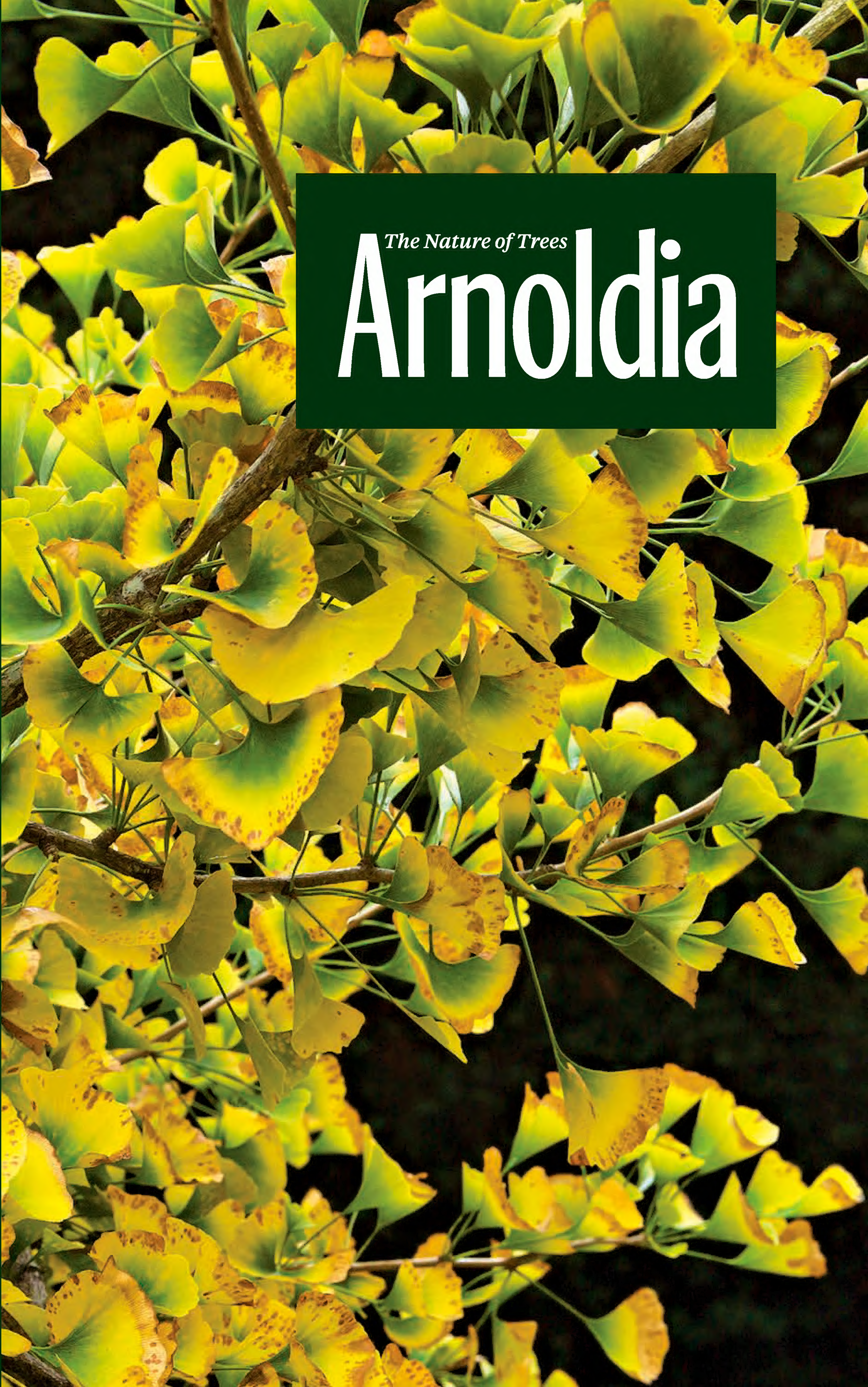

The Nature of Trees

Arnoldia

FALL 2022

Wild Hydrangeas   Battle of the Pines   Tree-Planting Politics   War and the Garden

FROM THE KEEPER OF LIVING COLLECTIONS

Being Green

By Michael S. Dosmann

While singing Joe Raposo's "Bein' Green," Kermit the Frog laments how he blends in—and fails to stand out—among more colorful and flashier things. Given how many plant species (including one third of trees) are threatened with extinction, "it's not that easy bein' green" should be their motto, too. In urban forests, tribulations trial our street trees to the point where we measure their lifespans in years not decades, leaving cities ever hotter and far less beautiful places.

Plant blindness, the term coined by James Wandersee and Elisabeth Schussler, is at play. When people fail to see the plants around them, they do not notice their beauty. Worse, they undervalue their essential role in supporting all life on Earth. I wonder if some have become phytophobic, in their carelessness.

As the world shifts from rural to urban and suburban living, we've become detached from plants, the very things that feed and oxygenate us. Even while many of us grow them, I fear we've also become alienated. To many, plants are just commodities, means to ends. I see it in the nursery catalogs we browse, the landscapes we design, the gardens we steward. We rush to buy the latest disease-resistant cultivar of elm, the hottest-off-the-press hydrangea, the newest, dazzling coneflower—each a must-have due to superb pest-resistance, 5-season interest, drought tolerance, pollinator-friendliness, non-invasiveness, maximum winter-hardiness, and a host of other traits folks claim the plants possess.

We demand a lot from plants in our managed landscapes, and those qualities are essential for many to survive. Yet among the attributes of new garden plants, I see a glaring omission: a richly authentic connection to a human, something that makes each individual stem stand out among its green brethren.

At the Arboretum, we do not grow trees: we jointly cultivate them and curate their narratives. Some of these are backstories that came with the plant; others emerge where they are growing. I may lecture to a class about Ernest Wilson's 1901 collection from China of the now-threatened paperbark maple, *Acer griseum;* a docent may share with a visitor Connie Derderian's heroic efforts saving the bonsai and penjing collection while its curator from 1969 to 1984.

This technique—sharing their backstories—may be a surefire way to inspire others to see plants, but it still doesn't go far enough. The student returns home from the lecture hall; the visitor departs the Arboretum. Motivated as they may have been at the time, the moment can be fleeting. People need their own personal, authentic connections to plants, too.

A richly authentic connection to a human makes each individual stem stand out among its green brethren.

I'm lucky to have a garden at home, where I grow plants replete with backstories important to me. Don't get me wrong—I grow quite a few eye-candy plants, too. Passersby from the sidewalk regularly ask the name of the shrub humming with bumblebees and awash with huge yellow blooms each July (*Hypericum frondosum* 'Sunburst'), and then follow-up wondering what that nearby mass of lacy, chartreuse vegetation is (*Rhus typhina* 'Bailtiger'). While they may be clickbait, these are not the real showstoppers.

I get access to surplus seedlings from my own expeditions, and a dozen have found space at home. When I watch each bloom of *Weigela decora* shift from cream to rose, I recall that slightly rainy September day in 2018, collecting it with colleagues in Nikko, Japan. As I cut back the *Hydrangea arborescens* every spring, I harken back to 2014, gathering seeds in the Ozarks, shouting warnings to fellow collectors about the cottonmouths and rattlesnakes underfoot. I also grow a *Stewartia rostrata* collected by Peter Del Tredici in 2004, in Lushan, China. Every time I see it, I think of Peter and our friendship. None of these plants is the most glamorous of its kind, but I'd not trade them for the showiest of cultivars sold in fancy containers.

I also grow plants passed down from family. A favorite is *Rudbeckia laciniata* 'Hortensia', often called golden glow, outhouse plant—or its most colorful moniker, shithouse daisy. We called them "grandpa's flowers," a name my mother grew up with, for her own grandfather dug them and other plants from the small farm in Hamlet, Indiana, loaded them in a horse-drawn wagon full of furniture, and drove the family to Sturgis, Michigan—a three-day trip. Sure, the plant can be ratty, the leaves covered with mildew by the end of summer. But, when I see those bright yellow pompon blooms, I smile and think of generations of gardeners sharing the plant and the story.

Plant lovers love to share plants. A decade ago, friends gave me fresh cuttings of a citronella-scented geranium (*Pelargonium graveolens*), which they in turn acquired as cuttings from a spontaneous plant sprawling on Mount Lycabettus, in Athens, Greece. My cuttings rooted and became houseplants that thrive under neglect. Last summer, I introduced the magic of plant propagation to one of the neighbor kids. Six-year-old Abe snipped a few stem cuttings, prepared and stuck them in a pot of basic soil (this geranium will root in anything!), and waited. They rooted, and a year later he has a lanky, smelly houseplant. Whether he tells the story of its Greek provenance matters little to me—what does matter is that he has his own authentic backstory connecting him to the plant.

By the end of his song, Kermit realizes that green is beautiful and exactly what he wants to be. Even when lacking fancy tradenames or cultivar epithets, the green beings in our gardens are beautiful when they have authentic backstories. As we grow the tried-and-true (as well as novel-and-new) plants for ourselves, our clients, our cities, we must also make room for those with personal stories to learn, preserve, and share. If none come to mind, we write them by sowing a seed, rooting a cutting, or adopting a nearby street tree to call our own. In doing so, we will all better see the plants around us. They need this, and so do we.

MICHAEL S. DOSMANN *is the keeper of living collections at the Arnold Arboretum.*

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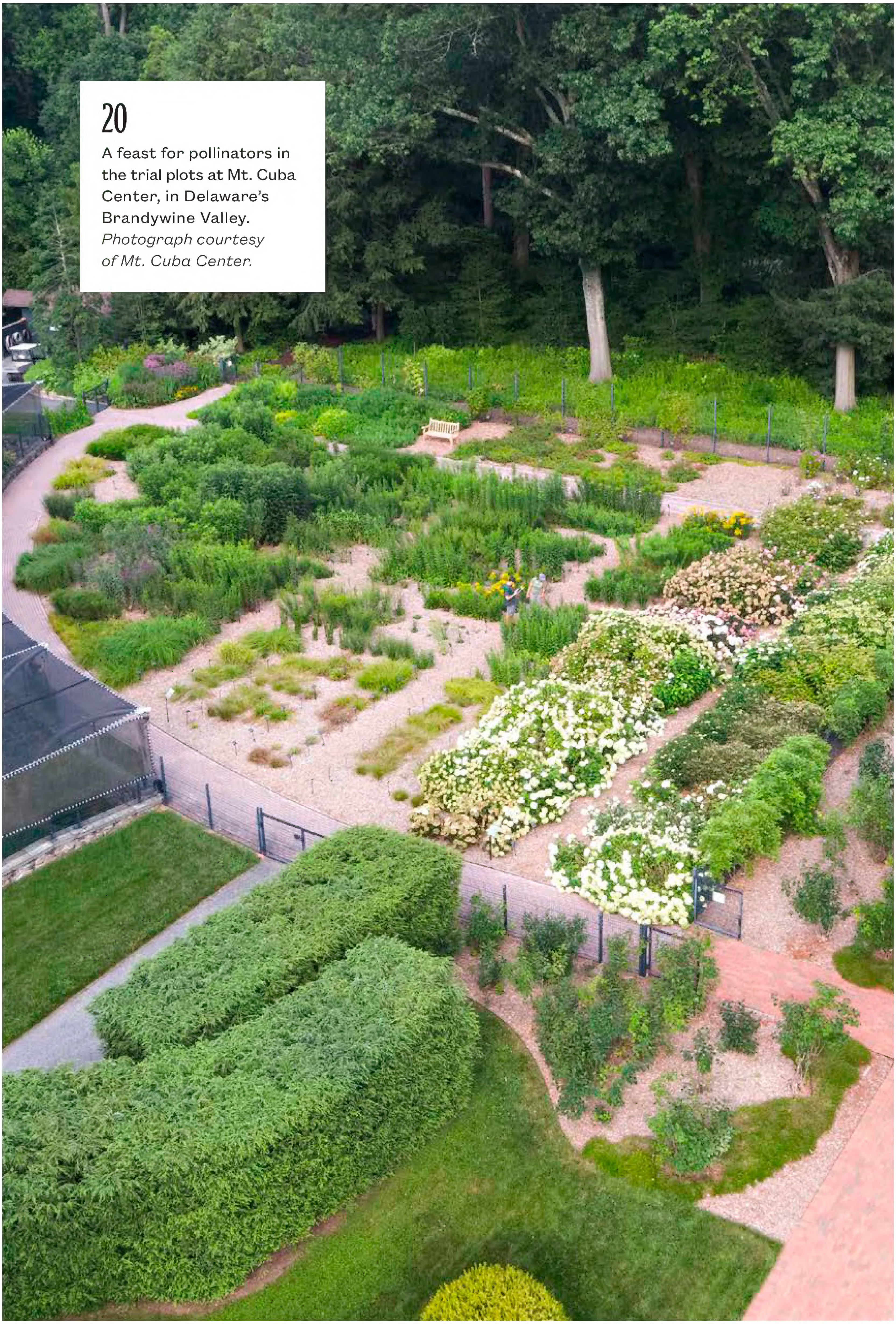

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A feast for pollinators in the trial plots at Mt. Cuba Center, in Delaware's Brandywine Valley. *Photograph courtesy of Mt. Cuba Center.*

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Arnoldia
The Nature of Trees

Volume 79 | Number 3 | 2022

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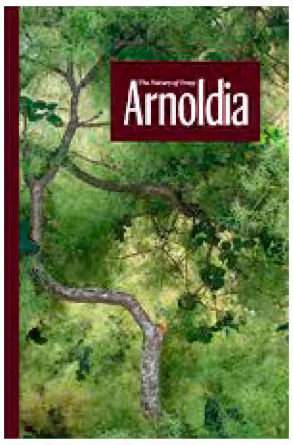

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Community

For *Arnoldia*, 2022 continues to unfold as a year of transformation. In January, the magazine bade farewell to editor Jonathan Damery, whose literary sensibility, passion for plants, and deep knowledge of the Arnold's collections saw the magazine through both the Covid era and a comprehensive redesign. Jonathan's influence remains with us, however, not only in *Arnoldia's* new look, but in his many essays, reviews, and other contributions—and we trust we haven't seen the last of these, as Jonathan moves forward with his writing practice.

The redesign has made room for new kinds of tree-entangled storytelling, and—in perhaps the most striking new development—contemporary poetry, welcoming into the pages both emerging voices like D. Allen ("Decomposition Hymn," Spring 2022) and long-practicing and celebrated poets (Stephanie Burt, "Lamb's Ear," Summer 2022). In this issue, we share two poems from the award-winning Jessica Fjeld, and look forward to continuing to offer *Arnoldia* as a venue for ambitious, provoking, lyrical verse in dialogue with trees. We're also bringing memoir, creative nonfiction, and visual art into our pages, with artist and essayist Éireann Lorsung's singular "Among white pines, at the foot of them" (see page 61 in this issue). Alongside the scholarly work on horticulture, botany, and landscape that remain *Arnoldia* mainstays, these new voices and perspectives connect our magazine with an expanding community of artists and writers engaging the nature of trees, landscapes, and the living world in new ways.

Our magazine. Let's keep the emphasis on the first-person plural—which includes you, *Arnoldia's* readers. Send us your ideas for articles, authors, and topics; let us know when a piece kindles your imagination, provokes your curiosity—or raises your blood pressure! We need your voice and vision to refine our own. Send letters to the editor through the mail to *Arnoldia*, 125 Arborway, Boston, MA 02130; or feel free to drop us a line by email via arnoldia@arnarb.harvard.edu.

Let us know when a piece kindles your imagination, provokes your curiosity—or raises your blood pressure!

The Downings of Newburgh

Dear Professor Elliott: I read with interest your article (Paul Elliott, "The Transatlantic Arboretum in the Nineteenth Century," in *Arnoldia* 79(2) Summer 2022, 32–41). It had quite a bit of information on A. J. Downing of Newburgh, NY, and his travels to England. As a "proud son of Newburgh," I sent my copy of *Arnoldia* to the Newburgh Historical Society and to the City Historian Mary McTamaney. Newburgh is where A. J. Downing and his older brother, Charles Downing, lived and had their nursery. This past Spring, there was a 150th anniversary celebration of the Downing Park in Newburgh, NY. Charles made significant contributions to fruit identification and cataloging—he tripled the size of A. J. Downing's "Fruits of America"—but rarely gets any mention for his work. The Downing Family is buried at the Cedar Hill Cemetery in Middle Hope, NY, one of the first "park-like" cemeteries to the created in the United States, which abides by the landscape concepts of Downing in its design.

J. Stephen Casscles

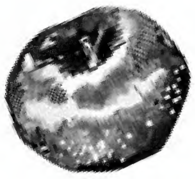
(The author grows heritage grape varieties and makes wine at the Milea Estate Vineyards, in Staatsburg, NY.)

ERRATUM: Due to a proofing error, the text of last issue's visual essay ("Drawn to the Edges" by Bobbi Angell, *Arnoldia* 79(2): 42–47) misattributed the introduction of *Corylus fargesii*, and misspelled the name of Michael Dosmann. The error has been corrected in the digital version of the issue.

An App for Your Arboretum

The Arnold Arboretum has treasured the stories of plants and people for 150 years. For visitors, however, these stories can be hard to find amid the green splendor of the landscape. That's where the *Expeditions* mobile app comes in. Available for iPhone and Android platforms, *Expeditions* enriches on-site encounters with the collection through photos, text, and audio, including more than fifty interviews with staff members, encompassing plant collecting, children's education, and research science. With loads of up-to-date content, the app offers guidance, enrichment, and discovery. To get started, go to the app store of your choice and search for *Expeditions*: *Arnold Arboretum*.

Notes from the Field



Incarnations of an Apple

Matt Kaminsky finds nature and nurture in a hilltown apple orchard in Western Massachusetts.

Matt Kaminsky goes by the moniker Gnarly Pippins in his work at the intersection of cidermaking, apple culture, orchard management, and wild-apple foraging.

It's fall in Massachusetts, and I'm traveling to a different apple orchard daily, making sure the fruit gets harvested on time from the different sites that I look after. Some days I find myself in the puckerbrush, tromping over blackberry and multiflora rose to reach piles of windfallen wild apples in abandoned pastures. Other days I spend my time with stately old trees laid out in rows. I love the variety of sites that I get to visit during this time of year. It's been very dry and mild this fall, so fruit is ripening nice and slowly. This allows plenty of time for making the rounds to the dozens of sites where I harvest. Starting with orchards located furthest south in my orbit, and ending with those furthest north, I will be busy during these twelve or so weeks ranging September to November.

I've just stopped to visit to a few noteworthy, unique seedling apple trees on the side of the road, collected their offerings, and continued on. In my truck I have some ovate, crow's-egg-looking oddball apples from one tree, which tasted like pineapple, next to a crate of large, round, green, and sweet-tasting ones, and another crate of aromatic fruit from an old hollow beast just next to it, which might be an old grafted apple called Mother. But those are just the bonuses. Today, my real goal is to check on the hilltown Baldwins—a very special instance of *Malus domestica* 'Baldwin'—growing in one of my favorite places. Some years ago, I was introduced to this old orchard by a former professor of mine, located far up in the hills west of the Connecticut River, on a homestead site in Franklin County. This remote site experiences its own microclimate, a bit colder than the surrounding countryside, and the blossom and fruit development are always further behind the orchards down in the river valley. Last week, I helped the crew at an orchard seated down in the valley at the base of Mount Norwottuck clean-pick the remainder of their 'Baldwin' crop, which had been steadily dropping fruit for a couple of weeks already. I'd estimate that the 'Baldwin' orchard up in the hills hadn't dropped a single apple yet, but that they'd be coming along at their own pace, ready to harvest any day now.

When I was first introduced to this special old orchard, it was in the middle of winter, and snow was falling. We couldn't tell what kind of apples the trees were. All I could see was perhaps two dozen hulking behemoths standing in the field, reveling in their dormancy. It also was apparent the trees hadn't been cared for in many, many years and badly needed pruning. My

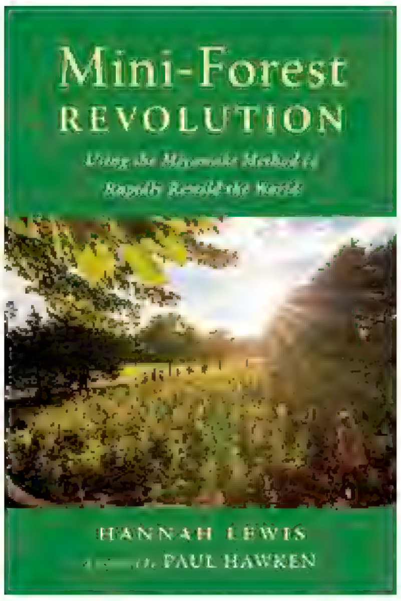
Illustration by Matt Huynh

professor had described the fruit to me in rich detail, which made my imagination race with wonder and anticipation. Come the first harvest after pruning, we learned that all but just a couple of the trees were Baldwins. One of the most iconic Bay State apples, their intense fiery red skin, balanced, sharp, subacid flavor, and signature hardness (so hard it may register on the Mohs scale used by geologists) are unmistakable. However, these are not just any 'Baldwin' apples. Though they are grafted, and therefore genetically identical with all other 'Baldwin' trees, these ones hit different.

They are ancient, massive trees. By counting the rings of limbs that I pruned off, and comparing to the size of the trunks, it is nearly certain that they pre-date WWII. History books and old timers alike hold that all the Baldwins in Massachusetts were killed by an unusually harsh winter in 1934, after which most growers gave up on the cultivar. Few intact 'Baldwin' orchards from that era remain. Some of the trees in this orchard have expressed the rootstock as multiple smaller trunks coming from the ground, producing different types of fruit than the main trunks, which produce Baldwin apples. Each individual tree's rootstock produces unique, intriguing apples, which don't resemble one another in any way. Their flavors are eccentric—some are more interesting than the Baldwins! This signals to me that this orchard was originally grafted onto seedlings rather than a standardized rootstock. Of course, each of the seeds they planted wouldn't come true to its parent, but rather would produce a unique apple tree. This is due to the trait of extreme heterozygosity that *Malus* displays, hence why the auxiliary trunks produce such wildly odd fruit.

Each tree's rootstock produces unique, intriguing apples, which don't resemble one another in any way.

Trees growing on seedling roots are generally known for their ability to thrive in adverse conditions, and indeed the soil here is somewhat inhospitable. From the fact that the main understory plant growing around the apple trees is lowbush blueberry, we can tell that it is very acidic. In most



BOOK BRIEF

Little Forest, Big Impact

Mini-Forest Revolution
Using the Miyawaki Method to Rapidly Rewild the World
By Hannah Lewis
Foreword by Paul Hawken
Chelsea Green Publishing, 2022, 224 pages

Protected from cutting for centuries, the forests that cluster around Japan's Shinto temples are refuges for endemic trees and the myriad creatures they support. Inspired by these biodiversity hotspots, botanist Akira Miyawaki (1928–2021) developed a method for intensive, site-specific cultivation of forest soil and cover, densely planting 30-40 regionally appropriate tree species to shelter seedlings and encourage rapid growth. As Hannah Lewis explains in *Mini-Forest Revolution,* the Miyawaki Method aims for big effects at hyperlocal scale, unlike most large-scale tree-planting efforts (for the fraught history and environmental impact of afforestation, read the excerpt from Rosetta Elkin's *Plant Life* in this issue, beginning on page 40). Author Hannah Lewis pairs case studies of Miyawaki projects from Europe to India with guidance on turning back lots into tiny forests. Editor at Biodiversity for a Living Climate, based in Cambridge, MA, Lewis first encountered the Miyawaki Method while living in France.

cases, soils that support prolific barrens of blueberries will prove too harsh for apple trees, which prefer a higher pH. Moreover, the extensive outcroppings of smooth, gray ledge throughout the orchard indicate that the topsoil layer is shallow. The roots have plunged through gaps and cracks in the stones to gain anchorage.

It would be hard to imagine an apple more intensely flavored, saturated in color, and sound of form. Piquing, sparkling acidity is coupled with plentiful juice and lovely, lingering, winey notes of tart cherry and a full mouthfeel. The 'Baldwin' apples from these hilltown trees are smaller, firmer, redder, and more flavorful than the orchard down in the river valley, where the harvest is just finishing up. Those 'Baldwin' trees are grafted onto MM.111, a widely-established commercial rootstock common in the US since the 1950s, and are at least forty years younger than those in the hilltown orchard. The valley trees also have a leafier, more upright growing habit than the twisty, winding branches of their older counterparts. The fruit is more plentiful, larger in size, and less intense in color, with little bits of green showing through. The juicy, firm flesh is rich in flavor, with notes of cranberry, but doesn't linger and isn't as complex. They lack the intense phenolics present in the older hill Baldwins, which add texture and depth, though they're still enjoyable.

> With the valley Baldwins and the hilltown Baldwins, the differences, slight or significant as they seem, are immutable.

The apples that I'm describing seem different from each other. In fact, if you didn't *know* that they were both 'Baldwin', you might not even be aware that they're the same type of apple, indeed genetically identical. How does the same scion, grafted and growing in two different locations, produce fruit so varied in appearance and flavor?

An apple fruit represents the sum of all variables that are a part of the tree and its surroundings. The genetic material contained within an individual specimen is filtered through a set of environmental and cultural qualities, which can vary greatly from place to place. Nature *is* nurture, the marriage of genome and environment. It is subject to the influence of all life around it; the activity of other organisms interacting with the tree, the qualities of the soil it's growing in, the weather, the influence of humans, chemicals, the rootstock they are grafted on, and so on. What appearances of the fruit are caused by the interactions of insects or disease? What flavors of the fruit are imparted by a particular deficiency or nutrient surplus in the soil? What practical elements of using the fruit, such as storage quality or size, are impacted by the tree's environment? What factors are we unaware of?

Once a variety like 'Baldwin' is widely established, the genetic blueprint, which is generally static and inextricable (except where mutations occur), is replicated many times via grafting. When it is grown over a wide geographic area and under cultural methods that differ greatly, we begin to see that many different incarnations of the same apple begin to appear. As with the valley Baldwins and the hilltown Baldwins, the differences, slight or significant as they may be, are immutable.

When I consider that 'Baldwin', as well as most named apple varieties, originated as a seedling, it makes me wonder how different the apples I'm experiencing today might be from the original 'Baldwin' tree that was discovered in Wilmington, Massachusetts, in 1740. How did the fruit from that original 'Baldwin' tree taste? How many millions of 'Baldwin' trees have lived and died since 1740? How many incarnations of 'Baldwin' have apple growers experienced? These are the questions that run through my mind with all apples I am eating, whether some famed old heirloom like these Baldwins, or some as-yet-unknown seedling, from an old rootstock, a roadside wild apple, or a tree found growing in the woods.

As seasons have come and gone, and I've had chances to taste the venerable 'Baldwin' apple from dozens of sites, from trees with different stories and different personalities, I can say with confidence that these oldest, most distinguished, and unique seedling trees produce my favorite incarnation.

The Sweetest Legacy

Carol Reese recalls her family's journey cultivating Asian persimmons on their Mississippi farm.

The Holsteins were gone, and watching our hayfields and pastures being reclaimed by the wild offered a sad reminder that dairy farming was no longer economically viable in north Mississippi. The land called for new purpose, which led to years of fruit growing experimentation, searching for a crop that had, as my mother put it, "maximum profit for minimal sweat equity."

Eventually we found that crop in Asian persimmons (*Diospyros kaki*), but for years, our quest was not always fruitful (and yes, the pun is intentional). Our running joke was that our most valuable lessons were learned by killing plants, usually because they were not suited to north Mississippi. Plant death was not always the issue, however, as sometimes failure comes by other means—as it did with our first project, a blueberry U-Pick venture.

The local extension service had suggested rabbiteye blueberries (*Vaccinium virgatum*) could supply huge profits with minimal inputs. They were right about little input. On some of our ideally acid soils, those rabbiteye blueberries planted some forty years ago still produce ample fruit with minimal care. Other factors denied profitability: while U-Pick blueberries were popular, locals usually only picked a few gallons and were done for the summer. And despite our efforts to acidify those places in the field that had unsuitably high pH, large swaths of the orchard simply did not prosper.

Realizing that blueberries weren't the answer, we set off on a series of jaunts to investigate other fruits and learn from other growers. We joined the North American Fruit Explorers (NAFEX) organization, attending the annual meetings that moved each year to different regions of the country. This generous community provided lifelong friends and mentors, from whom we learned to become decent grafters, with only minimal blood loss.

We also learned, the hard way, that Mississippi has the perfect climate for growing disease. Plants we saw thriving in California, Michigan, Oregon, and New York swooned in our heat and humidity. My father, however, was a civil engineer, and adept at finding solutions. When it became obvious that southerners needed their own group, a drawling band of commercial and amateur growers came together to form Southern Fruit Fellowship. Like NAFEX, the meetings moved around to different regions, but always in the south, and it was in Florida that my parents bit into their first Asian persimmons (*Diospyros kaki*). My father said it was love at first bite. They took a picture of the smiling moment.

This fruit fit the bill for a U-Pick business: it ripened in mild, beautiful October, and customers filled five-gallon buckets in a matter of minutes. The trees required little maintenance beyond pruning to develop low spreading trees, shaped to accommodate strolling fruit-pickers. Mowing between the rows was a task maintained intensively only during harvest season.

There was still a learning curve. Our farm lay in Zone 7, the hardiness limit for

Carol Reese is a speaker, writer, and extension horticulture specialist in Jackson, TN.

Illustrations by Matt Huynh

most Asian persimmon cultivars, with wildly fluctuating temperatures in seasons of transition. We learned to plant in spring, giving trees time to settle in well before a challenging winter. We also had survival issues with trees grafted onto *Diospyros lotus* rootstocks, so began using American persimmon (*Diospyros virginiana*). They occurred naturally on our farm, so we collected and planted several seeds directly into the desired spot, selected the most vigorous of the seedlings to graft, and left a couple of ungrafted seedlings in place for a year or two alongside the newly grafted trees. These would serve as backup rootstocks, should the grafted plant come to ruin, and they helped shield the tender new graft from wind gusts or racing dogs. Later, these extras were transplanted into pots and grafted for orchard expansion or sold to local nurseries.

Our first year of significant production found us in a new dilemma. Our delicious, beautiful Asian persimmons attracted very few customers! This was before the days of social media, and in an era of less cosmopolitan palates. Even more to the point, an aversion to persimmons was common among our usual clientele. As children, many had been tricked into biting into a firm American persimmon, which is astringent until it has softened. The memory of the lingering pucker caused by that unripe fruit made them understandably reluctant to be suckered (puckered?) again. Our first plantings were all non-astringent cultivars, however, and delicious even when hard as an apple.

Many had been tricked into biting into a firm American persimmon, which is astringent until it has softened.

Could they be convinced to try one? Each fall, my parents set off for local farm markets and horticultural field days with cutting boards, sharp knives, and bushels of just-picked persimmons. For hours, they sliced the beautiful orange persimmons and challenged total strangers to try the crisp wedges. I helped occasionally and enjoyed

URBAN ECOLOGY

Happy Bats, Healthy Cities

COVID-19 was hard on the public image of bats, who already suffered a reputation as carriers of disease. In fact, they contribute to human health, checking populations of mosquitos and agricultural pests—and many aid in pollination and seed dispersal, too.

Since 2021, students supervised by Dr. Alison Robbins of Cummings School of Veterinary Medicine at Tufts University have studied bat populations in living laboratory of the Arnold Arboretum. This year, Conservation Medicine graduate student Christina DeJoseph (left, in the field) installed monitors to collect bat calls and the sounds of other species. Supported by the Arnold's Sinnott Award, DeJoseph is tracking acoustic biodiversity to map how bats contribute to public health and healthy ecosystems. With veterinary student Alex Debrindisi, DeJoseph also offered a series of public "bat walks" at the arboretum to foster public fascination. "Taking interest in the other species we live with," DeJoseph points out, "that's healthy, too."

To learn more about the work of Cummings-School students in the arboretum's landscape, look for the bat "wonder spots" at arboretum.harvard.edu/visit/explore-with-us/.

seeing the expression of doubt change to delight as they gingerly bit into the crunchy sweetness. Converted! Faces went from wary to warm, and soon our booth would be buzzing with questions and conversations.

Nearby Starkville had another customer base, eager and ready-made: its vibrant Asian communities. These excited new customers taught us proper pronunciation of the cultivar names, and the resulting friendships brought to our farm an unexpected and rewarding cultural exchange.

Thanks to those early efforts, the crop now consistently sells out as fast as it ripens. The only advertising done is to announce opening day for picking season and hours of operation.

My parents are buried not far from the orchard, and my little brother now runs the operation, but some of their early customers still come, as well as the children and grandchildren of those first customers. The tradition of picking brilliant orange fruit on a beautiful autumn day spans generations, and our farm's soil has become part of their growing families.

Several years before their deaths, my parents told their seven children the only gifts they wanted were memories of time spent happily with family. I smile to think that Reese Orchard still provides that opportunity for so many, long after they are gone. It's a different measure of success, beyond an orchard's profitability, and is their enduring legacy.

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The Habitat of Childhood

Ana Maria Caballero shares the magic of nature with young learners in the arboretum.

Recently I took a small group of kindergartners on a forest walk atop an esker at the Arnold Arboretum. A tree-covered, glacial ridge, it was a cool and shady spot on an otherwise sunny, hot, dry day. A red robin seemed to be leading the way, lowering its head while running and lifting it when stopped, keeping an eye on us as we observed it carefully. It disappeared behind a downed log covered in moss. The children were immediately drawn to it, touching the green velvet and looking for spiders and ants. Across the path, a child discovered the lower part of the downed log: a wide, hollowed-out snag that created a life size cocoon big enough for six children. They all quickly settled inside, perching on the damp decomposing wood continuing to look for spiders and other creatures. One child commented, "Sometimes you can find salamanders in the woods," to which I replied that it's been so dry lately that most of them have gone deeper underground. "That's because there is water underground, right?" she asked. After a few silent moments she asked, "Do you think we are walking on salamanders?" I was so surprised by this insight and this moment: fearless children connecting to the natural world with curiosity and joy.

Sharing such experiences of young children in nature, and how to promote more of them, is what prompted the convening of a panel of outdoor educators at Boston University this spring. As Outdoor Educator at the Arnold Arboretum, I support Boston Public School students who come for guided and self-guided field trips to learn in our landscape, as well as train our volunteers and offer professional development for educators throughout the year. As such, I have long followed research affirming the many benefits of nature to adults and children. Health benefits include lower blood pressure, reduced stress, a boost to the immune system, and increased anti-cancer proteins. Cognitive gains include improved focus and higher scores on standardized tests. Other benefits include fewer sleep difficulties,

Ana Maria Caballero is Outdoor Educator at the Arnold Arboretum.

Illustration by Matt Huynh

faster healing after illness, increased emotional resilience and stronger mental health.

Recently, doctors have pegged Computer Vision Syndrome (CVS) as a direct consequence of too much screen time, and there is a documented increase in myopia (nearsightedness) in young children. Surprise! Being outdoors can alleviate these symptoms, as children look out in the distance and relax the eyes.

But the benefits extend far beyond this, as I have seen with the children who attend our field study programs—two-hour landscape explorations of specific life-science content, which happen in small groups led by trained volunteers. Unlike a snake-oil salesperson, I can say that we truly have the remedy for so much that ails us. I've noticed so many benefits; at the BU panel I discussed just five, which I share with you here.

Once the child catches their first bee or centipede, all worry, fear, and disgust goes away.

Active Agency in Learning

Learning outdoors teaches children a sense of scale and perspective, reinforces the cyclical nature of time and space, and introduces children to experiences and words upon which later learning is built. This is how background knowledge is created. Children become the star when they experience the concept: seeing the seasons change, following the germination and growth of a plant outdoors, discovering the effects of a rainstorm on the earth, breaking apart stones, "climbing" the shadow of a tree limb or coming face to face with a snapping turtle for the first time. These experiences introduce vocabulary and demand that children narrate what they see, hear, and feel. In response, they use words in context, invent words creatively, and make connections between English and their first languages. This is learning that integrates physical, cognitive, emotional, and social domains; this is learning that puts the child in the driver's seat.

Context

Being in nature brings book and classroom learning to life by putting all that information in context. We begin with the premise that science is learning about the world around us, and the world around us *is* the natural world. Vocabulary and concepts make more sense when children can touch, smell, hear, and explore these same words and concepts in real life—in context. It is here that we can see that a holly leaf has sharp prickles to prevent herbivory, or that a hawk does not always catch the snake, or that vines have tendrils that curl "just like my hair!"

This story illustrates the need for context: An elementary age child confessed to one of our guides that she was afraid of squirrels, with their big front teeth, rat-looking faces, and size. When the guide asked this child "how big do you think a squirrel is?" the child indicated with her hand an animal about two feet tall! This child had never really seen or noticed a squirrel in context, perhaps, but only in books or movies. I have seen firsthand how being in natural context has helped children overcome perceived misconceptions and fears. Once the child catches their first bee or centipede in a bug box, all worry, fear, and disgust at the task goes away—they can't get enough of digging through leaf litter looking for critters, or appreciating the pollen baskets on bees' legs.

Messiness

The outdoors is messy! Unexpected things happen to frustrate, delight, and surprise every day. The rain begins to fall. You come across a dead squirrel. The salamander you so very much wanted to see didn't make an appearance. Someone left their dog-poop bag on the path. A tree has to be cut down because of a storm. A coyote follows a dog on a leash. When children encounter unexpected events, they learn to manage disappointment, and perhaps fear or worry, in proportion with the encounter—especially when they are involved in addressing and finding solutions for the situation. They learn to be flexible and to come up with alternatives. Tolerating discomfort that comes from unpredictable and messy nature leads children to develop a sense of personal competence. Part of growing up is learning how to release these negative emotions in the face of inevitable stress. If kids never figure out how to do that, they're more likely to experience severe anxiety as teenagers. These experiences outside are often the most memorable of unexpected wonders. An adult's job is to help children navigate these surprises with respect, simplicity, and empathy.

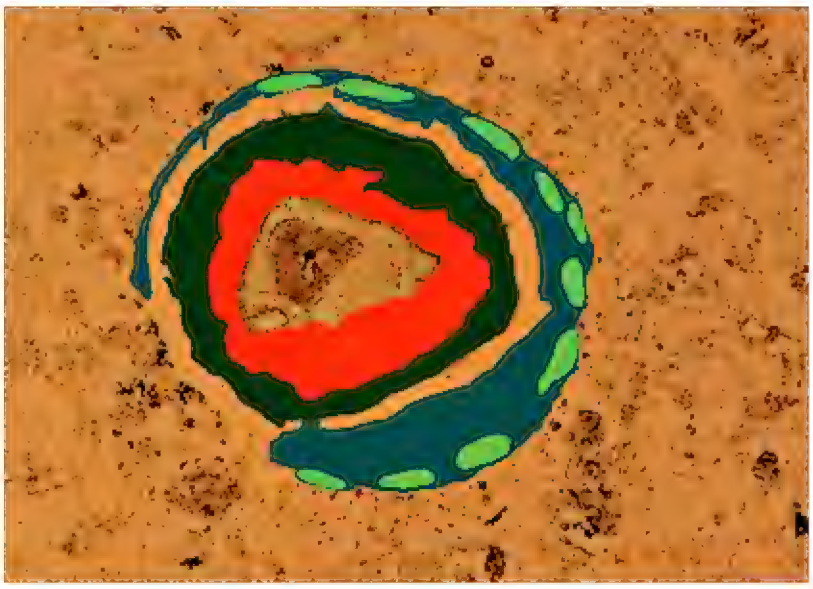
Global Citizenship

Children who are outdoors learn from a very young age that their actions and interactions with the natural world affect the natural world. It is one thing to be indoors and learn about trash or talk about how cutting trees is bad for the environment. It is quite another to see the effects of human activity on our world. When children see trash in the water stream, a tree branch broken under the weight of a climber, or dry, yellowing fields at the height of summer, they are primed for conversations that can center on activism and purpose. Young children who learn to love the outdoors are more likely to become adults who work to preserve it for future generations.

Magic

So often after a session, young children tell us that they don't want to leave, they want to live here forever, they see the Arboretum as a magical place. They are filled with possibility. Very quickly, many children come to feel a sense of belonging that comes from the peace, calm, and happiness that they experience in the outdoors. *Joy.* They want to share this place with their families, they want to come back.

As educators, parents, and caregivers, we need to be intentional in letting children be children for as long as possible. Childhood and the natural world are wonderful spaces to be in. This habitat of childhood needs to be tended and protected. If we do it right, this magic stays with them throughout life.



TREE OF LIFE

Mesozoic Mystery

Our picture of the rise of the angiosperms, and the extent of plant diversity when they first arose some 140 million years ago, is far from complete. Sadly, many of the now extinct groups of non-flowering seed plants that might help reconstruct the evolutionary history of the rise of angiosperms remain undiscovered. A species of Mesozoic plant, newly described from fossil evidence in a recent issue of the *American Journal of Botany,* may shed light. The authors suggest possible affinities between early flowering plants and the new species, a gymnosperm, which they have named *Xadzigacalix quatsinoensis* (the genus name incorporates the word for "plant resin" [*xa'dziga*] in Kwak'wala, the language of the Kwakwaka'wakw nations of northwest coastal North America, on whose traditional territory the fossil was found). The case is far from resolved, however: is the plant indeed related to early angiosperms—and if so, does it have anything to tell us about their origin? How are other cupulate seed-bearing groups of Mesozoic plants related to each other and to flowering plants? While such questions remain topics of palaeobotanical debate, this much is clear: the buried remnants of the Mesozoic still have many secrets yet to be revealed.

Klymiuk, A. A., Rothwell, G. W., and Stockey, R. A.. 2022. A novel cupulate seed plant, *Xadzigacalix quatsinoensis* gen. et sp. nov., provides new insight into the Mesozoic radiation of gymnosperms. *American Journal of Botany* 109 (6): 966–985. Image: Cross-sectional reconstruction of *Xadzigacalix quatsinoensis,* through apex (micropyle) of ovulate reproductive structure. Klymiuk, Rothwell, and Stockey (2022). UAPC-ALTA P15375 D. CC BY 4.0

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Helwingia

By Andrew Gapinski

As a student of horticulture in the Midwest of the US, I was fascinated by the floral characteristics of the eastern redbud (*Cercis canadensis*). The reddish-purple flowers and brown pea-like fruits are borne directly out of the bark of older wood of main trunks and stems rather than newly emerging growth. This phenomenon, known as cauliflory, is most prevalent in tropical species including coffee and cocoa. Although still intrigued every time I see it, I am even more enthralled by epiphylly, when flowers and fruits (as well as other structures) grow attached to leaves (often the midvein). At the Arnold Arboretum, epiphyllous flowering can be observed on a single specimen of *Helwingia japonica* (AA# 912*MASS) in the Explorers Garden, received in 1880, likely a propagule from the first introduction of the species into European cultivation.

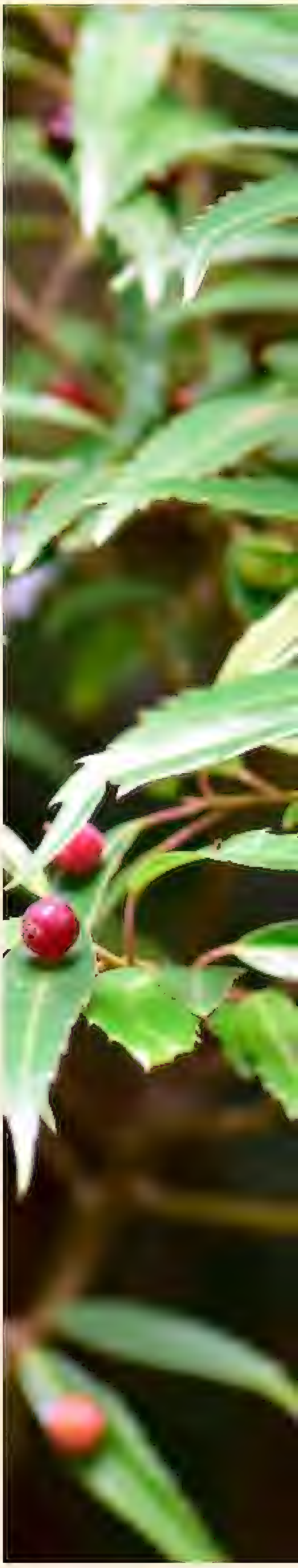
Alone in the Helwingiaceae, genus *Helwingia* contains four species occurring from the Himalayas to Japan. Either evergreen or deciduous, all are shrubby, epiphyllous, and dioecious (bearing male and female flowers on separate plants). The Arnold's 1880 specimen is male, and currently lacks a paired female plant for successful reproduction.

In 2018, I traveled to the Shennongjia region of Hubei Province, China, as part of the North America-China Plant Exploration Consortium. Along with important germplasm for conservation, we collected seeds of two species of *Helwingia: H. japonica* and *H. chinensis*. Both were found growing on shaded rock outcrops in rich pockets of humus soil in association with the conifer *Torreya fargesii*.

Helwingia japonica's broad, deciduous leaves sport umbels of tiny, four-petaled flowers in spring, developing into pea-sized black drupes in autumn. *Helwingia chinensis,* by contrast, is a semi-evergreen species with narrow leaves bearing purplish male flowers on long stalks (pedicels) in groups of 4-5; female flowers are nearly sessile (unstalked) and in groups of 1-3 with fruits ripening to a glossy cherry red.

We now have one plant from each species in the Arboretum's Dana Greenhouses. The *H. chinensis* plant, a male, bloomed copiously this year. Over the past 150 years, we have made several attempts to cultivate this species in the collections—each to no avail. If this collection is successful, we'll need to find it a mate by collecting it again.

Andrew Gapinski is Director of Horticulture at the Arnold Arboretum.



Helwingia chinensis in fruit. *Photograph by Kang Wang.*

COLLECTIONS IN PRACTICE

The Wild Hydrangeas of Mt. Cuba Center

By Sam Hoadley

When I bought my house five years ago in Chester County, Pennsylvania, I inherited a landscape with a garden tradition dating back to the 1940s. Mature specimens of choice woody plants are bountiful and include a grove of mature dawn redwoods (*Metasequoia glyptostroboides*), three massive franklinia (*Franklinia alatamaha*), and one large and aged smooth hydrangea (*Hydrangea arborescens*). The identity of this smooth hydrangea cultivar is not known, but due to the age and the substantial sprawling nature of the planting I suspect it to be *Hydrangea arborescens* 'Grandiflora', formerly sold under the name 'Hills of Snow'. This cultivar was originally selected

Lacecap inflorescences of *Hydrangea arborescens* are highly attractive to pollinators. *All photographs in this article courtesy of Mt. Cuba Center* from a wild population of *Hydrangea arborescens* in the early twentieth century, and is still available from specialty growers today.

Hydrangea arborescens 'Grandiflora,' along with the similar and more popular *H. arborescens* 'Annabelle', are staples of American horticulture that are readily recognized by expert and novice gardeners alike. Their oversized, dome-shaped inflorescences borne in June and July have classic ornamental appeal, but these cultivars are not without their shortcomings. Both 'Grandiflora' and 'Annabelle' have floppy habits, a flaw that is exacerbated by summer storms right when the blooms are at their peak. For this reason, I had always considered these cultivars to be horticultural relics and, admittedly, gave little consideration to the use of the species in modern landscapes. My insular outlook was quickly challenged, however, thanks to my inheritance of a comprehensive trial of smooth hydrangea when I was hired for my current role of Manager of Horticultural Research at Mt. Cuba Center in Hockessin, Delaware, in March of 2019.

Mt. Cuba Center, situated in the rolling hills of New Castle County, Delaware, is the former estate of Pamela and Lammot du Pont Copeland. The Copelands envisioned that Mt. Cuba could be a place to inspire an appreciation for the beauty and value of native plants and spark a commitment to protect the habitats that sustain them. This original intention lives on as Mt. Cuba Center's core mission, and continues to guide the organization to this day. After Mrs. Copeland passed away in 2001, the transition from private estate to public garden began in earnest. In 2002, the Copelands' cut-flower plot was repurposed to serve as a trial garden. In this space, native species and cultivars were grown side by side to determine their horticultural qualities in a low-maintenance common garden setting. The first research report was published in 2005, describing findings from a three-year trial on asters, including floral display, habit, cultural adaptability, winter hardiness in Zone 7a, and disease resistance. This publication highlighted and recommended the top-performing plants to gardeners and nurseries in the mid-Atlantic region, and served as a template for future research reports. A report on *Echinacea* was released in 2009, and in 2011, the trial garden was redesigned with a new perimeter fence, brick walkways, and a shade structure. The shade structure proved to be an invaluable tool, not just for trialing shade-loving species, but also for comparing the performance and adaptability of trialed plants when they are cultivated in both sun and shade.

In 2013, Mt. Cuba Center opened its doors to regular public visitation for the first time, and the trial garden welcomed visitors to observe and interact with trials in progress. Under the deft management of George Coombs, publication of the trial garden's research reports became a highly anticipated resource valued by the public and nursery industry. Trials were established in a staggered rotation so that four trials run concurrently, with one trial concluding each year. In addition to promoting plants with excellent garden qualities, the *Coreopsis, Monarda,* and *Phlox* reports aspired to address the ecological services that these species and cultivars provide by collecting comparative pollinator data on the various species and cultivars in each trial. Pollinator studies quickly became an important component of Mt. Cuba's trial program, and have allowed consumers to make informed decisions about which plants have the most capacity for attracting and supporting pollinators in their home landscapes

Quantitative and qualitative horticultural data are collected in the trial garden on a weekly basis between April and September. Scores are assigned that reflect habit, form, foliage, and other ornamental qualities that the plant may exhibit. For example, a weak plant with a floppy habit might receive a low score, while a vigorous plant with a robust and non-floppy habit would receive a high score. A separate rating is assigned to the floral display when the plants are in bloom, and an additional rating assesses disease resistance, which becomes especially important when observing plants that have a known susceptibility to specific pathogens. At the end of each season an overall score is generated for each plant. At the conclusion of the three-to-five-year evaluation, the scores from each year are averaged to determine the final horticultural score. In the most recent trials of hydrangea and *Echinacea,* supplemental points were then awarded to plants that attracted the most pollinators. This supports our initiative of promoting plants that are both beautiful and also have wildlife value. The top performing plants are then featured in subsequent research reports. For some gardeners, selecting a native plant for its ornamental qualities is enough, but for others this is only part of the greater story of providing habitat and food sources for wildlife in their home landscape.

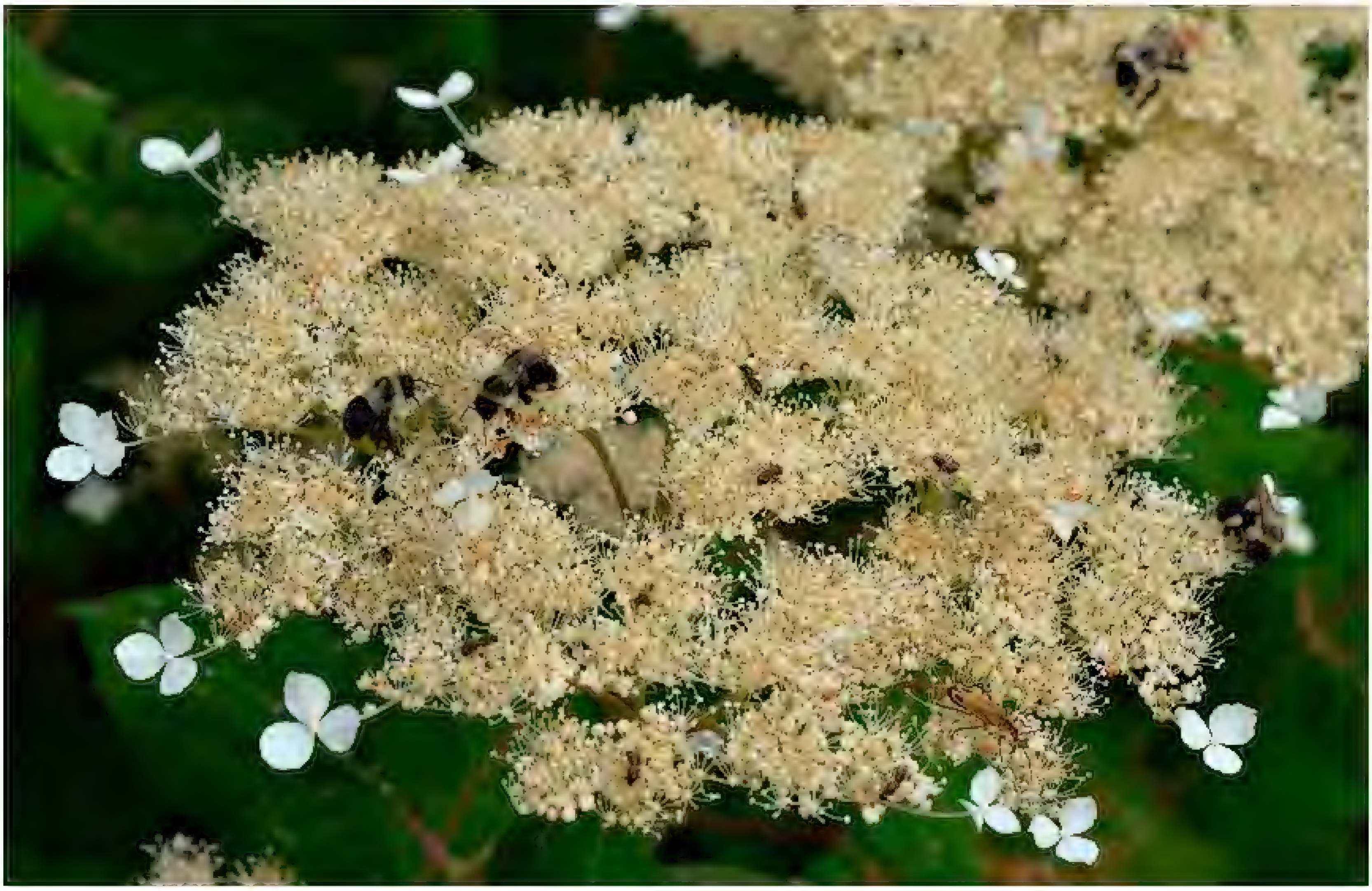
Pollinator data are collected by a cadre of Mt. Cuba Center's citizen scientists, called the Pollinator

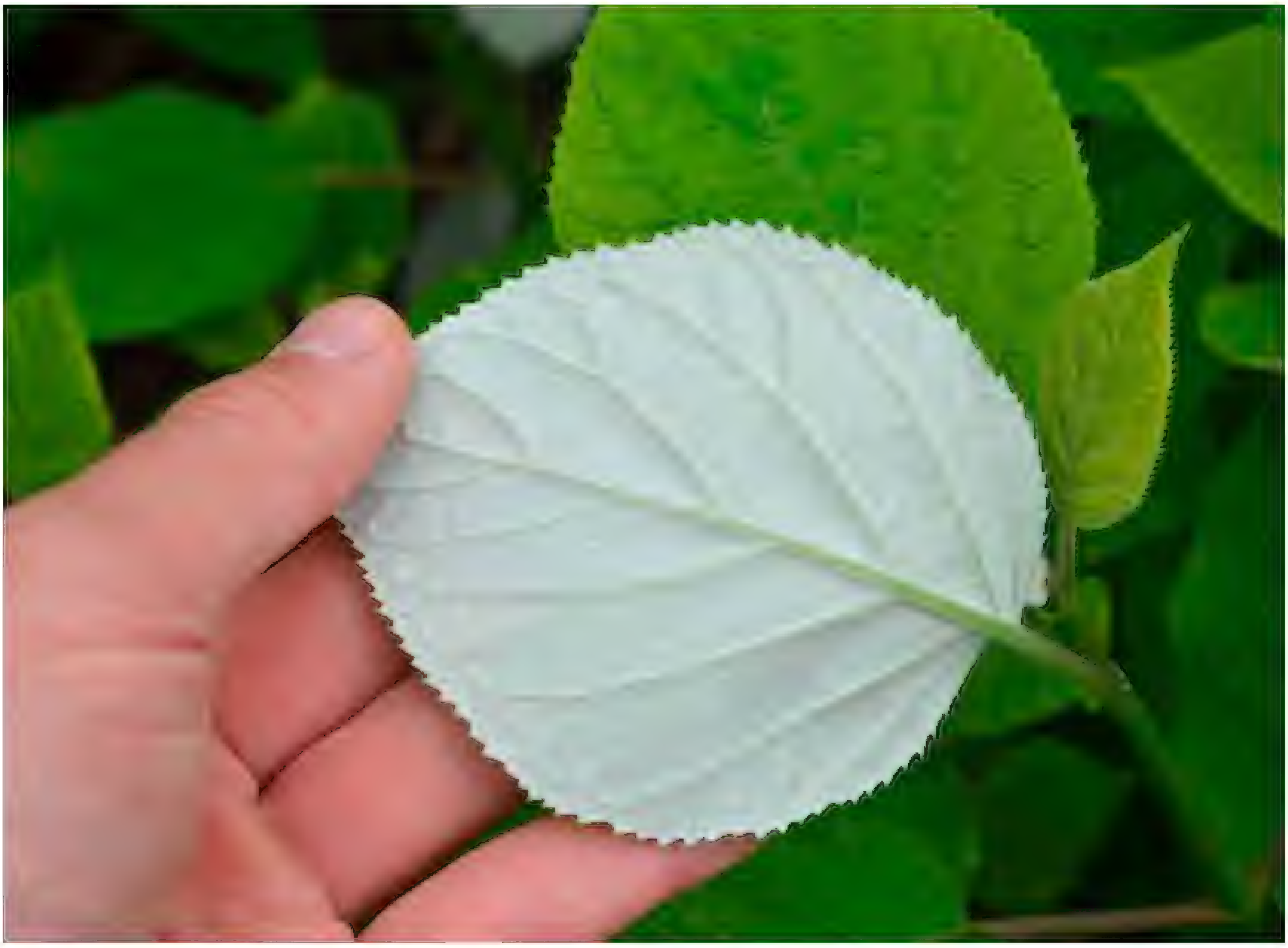
Hydrangea arborescens ‘Annabelle’ showing its characteristic floppy habit.

Watch Team. On a near-daily basis, these volunteers observe plants in bloom for 60 seconds and collect information on insect visitors. Counts are made on one plant per accession, or single inflorescences if blooms are numerous or plants are prohibitively large. The number of pollinator visits is recorded, along with the time, weather data, and additional observations. In some trials, all pollinators that visit the plant or inflorescence are counted, while in others, only targeted groups such as butterflies or hummingbirds are recorded. The results of these studies help homeowners make informed decisions about which plants in our evaluations have the most capacity to attract and support insect pollinators. These data become particularly relevant as natural habitats face increasing threat of destruction. Home gardens are uniquely poised to temper those losses, and can help provide small oases for wildlife in the midst of food deserts comprised of the turfgrass and non-native foundation plantings that make up the majority of home and commercial landscapes today. By pointing people in the direction of beautiful and beneficial native plants, Mt. Cuba Center can help people become conservators.

When I was hired as Manager of Horticultural Research in the early spring of 2019, I was greeted with four in-progress trials: *Helenium*, *Echinacea* (the second trial of this genus), smooth hydrangea (or “wild” hydrangea, as they are called at Mt. Cuba Center), and *Carex*. Smooth or “wild” hydrangea represented the first woody plant trial at Mt. Cuba and had just begun the third year of a five-year evaluation. While the study of woody plant material represented a step into new territory for the trial garden, it was a logical one. There is an increasing demand from homeowners for reliable information on alternatives to non-native woody landscape plants that are low maintenance, beautiful, and providers of wildlife value whenever possible. Included in the smooth hydrangea evaluation were three species of hydrangea native to the eastern United States: *Hydrangea arborescens, Hydrangea cinerea,* and *Hydrangea radiata*. *Hydrangea arborescens* was the primary species evaluated, and is the wild version of most of the twenty-six cultivars in the trial. *Hydrangea arborescens,* or smooth hydrangea, has the largest native range of the three species and can be found in much of the eastern and central United States, By pointing people in the direction of beautiful and beneficial native plants, Mt. Cuba Center can help people become conservators.

In the wild, *Hydrangea arborescens,* or smooth hydrangea, has the largest native range of the three species and can be found in much of the eastern and central United States, often on shaded moist slopes.





Top, *Hydrangea cinerea*, or ashy hydrangea, is exceedingly rare in cultivation. Bottom, *Hydrangea radiata*, or silver-leaf hydrangea, with the smallest native range of the wild hydrangeas, is readily recognized by the silvery undersides of its leaves.

As I continued down the path to the lacecap hydrangeas, I was greeted with an immersive audible and visual experience composed of hundreds if not thousands of insects.

often on shaded moist slopes. *Hydrangea cinerea,* or ashy hydrangea, is exceedingly rare in cultivation and can be found primarily in the central and southeastern United States. The best identifying feature of ashy hydrangea is the concentration of white to grey pubescence on the stems and the backs of their leaves, which differs from the relatively hairless foliage of *Hydrangea arborescens*. *Hydrangea radiata,* or silver-leaf hydrangea, has the smallest native range compared to *Hydrangea arborescens* and *Hydrangea cinerea* and can only be found in a handful of states in the southern Appalachian Mountains. The most striking feature of *Hydrangea radiata* is the bright white undersides of the leaves making this perhaps the most easily identified and inherently ornamental species of the three in our trial. Silver-leaf hydrangea was also the first to bloom in our trial in mid-June while the other two species started blooming in early July each year. While the three species vary slightly in size, habit, and overall appearance, each flowers on new wood and produces superficially similar inflorescences. The three species, including two distinct accessions of *Hydrangea radiata,* were all propagated from wild collected stock from the collection at Mt. Cuba Center, and these plants acted as the controls against which all of the cultivars would be compared. Twenty-five cultivars were then sourced from various arboreta and nurseries, in most cases representing material available to homeowners at that time. All twenty-nine hydrangea accessions were grown in full sun and nineteen cultivars were also grown in shade for comparison. Since these shrubs bloom on new wood and flower buds are not produced until the start of the growing season, smooth hydrangea can be heavily pruned in late spring and flowers are still reliably produced in June and July. To assess response to pruning, one example of each hydrangea grown in full sun was cut back to approximately six to eight inches from the ground in late March 2019, 2020, and 2021. The remaining examples of each hydrangea served as the control group and were left unpruned for the duration of the evaluation.

That first spring at Mt. Cuba, before the hydrangea had even leafed out, I was struck by the diversity of form, texture, and even stem color. Subtle variations between similar cultivars and species were readily apparent when the plants were grown side by side. It became obvious to me how short-sighted I had been when I had written off smooth hydrangea for my own garden use. There was clearly so much more to this group of plants than the old standbys, like *Hydrangea arborescens* 'Grandiflora' and 'Annabelle'.

As spring progressed and data collection began, I looked forward to what I knew would be a spectacular floral display in June and July. When the time came, the flowers were indeed breathtaking, and included a concert of white and pink inflorescences that fell into two distinct categories: lacecaps and mopheads. Lacecap smooth hydrangea species and cultivars produce flat-topped, corymbose inflorescences that are primarily composed of masses of fertile flowers that number anywhere from 800 to 2,000 individual flowers. Around the perimeter of many lacecap flowerheads are a small number of sterile flowers that give the inflorescences their trademark lacy appearance. Lacecap inflorescences are the predominant flower form found in wild populations of *Hydrangea arborescens,* and offer visiting pollinators highly accessible nectar and pollen rewards. *Hydrangea arborescens* and *Hydrangea radiata* both produced lacecap inflorescences that averaged around 4.5 inches in diameter, although the sterile flowers of the silverleaf hydrangea were noticeably larger than those of the smooth hydrangeas. The fertile flowers of *Hydrangea radiata* were also less tightly clustered than those of *Hydrangea arborescens. Hydrangea cinerea,* on the other hand, produced the smallest diameter flower heads in the trial at around 3.5 inches on average, and also some of the smallest sterile flowers. Despite the smaller diameter, the inflorescences of the ashy hydrangeas were tightly packed with fertile flowers and were heavily visited by pollinators.

In contrast, mophead hydrangea blooms are often more dome-shaped and produce a much higher number of sterile flowers per inflorescence, giving them their iconic billowy cloud-like appearance. In most cases, fertile flowers are still produced, but in much lower numbers than their lacecap counterparts. In addition, these fertile flowers are often sequestered within the inflorescences, reducing their accessibility for some insects. Some mophead smooth hydrangeas such as *Hydrangea arborescens* 'Annabelle' are selections made from naturally occurring anomalies found in nature. However, not all mophead smooth hydrangeas in cultivation are the products of simple selection. Wild-origin mutations form the genetic building blocks utilized by modern plant breeders to cross and further select smooth hydrangeas. The progeny of these breeding programs feature ornamental and horticultural improvements as well as novel garden traits.

The trial at Mt. Cuba was planted with mophead cultivars concentrated on one end of the planting bed and lacecap cultivars and species planted on the other. As I walked through the blooming mophead cultivars, the inflorescences were beautiful, but the surroundings were quiet and relatively devoid of insect pollinators. As I continued down the path to the lacecap hydrangeas, this changed, and I was greeted with an immersive audible and visual experience composed of hundreds if not thousands of insects. Bumblebees, wasps, beetles, true bugs, and flies busily collected pollen and nectar from the fertile flowers of the lacecap inflorescences in a frenzy of activity. I was in awe, not just because of the huge number of insects I was witnessing, but also by the stark contrast between the two flower forms and the obvious preference that the various pollinators displayed for the lacecap smooth hydrangeas. One lacecap cultivar in particular, *Hydrangea arborescens* 'Haas' Halo', completely captivated me. Not only was it covered with pollinators but here was a robust plant with an incredible floral display that rivaled any of the mophead cultivars in the trial. This was an example of a plant that encapsulated Mt. Cuba's mission. This ornamentally superior and garden-worthy native plant inspired an appreciation for its beauty and for the ecological value that this plant was clearly providing to scores of insect pollinators. I was so taken by *Hydrangea arborescens* 'Haas' Halo' that I ordered one for my home garden that same day.

This single experience in the trial garden constituted a personal paradigm shift in the way I looked at horticulture and my own gardening practice. There was room for beauty and ornamental interest, which had always been a priority, but ecological value did not have to be sacrificed. In fact, gardening for insects and other wildlife quickly became a focus for me, and has been a deciding factor for the vast majority of my home-garden additions ever since. This one plant has inspired me to take conservation action by planting a native shrub with high ecological value in my home landscape. And I was not alone. Over the next three years, I fielded countless questions about *Hydrangea arborescens* 'Haas' Halo' from visitors who had experienced this plant for the first time in the trial garden just as I had. They all wanted to know where they could buy one. This is exactly the kind of inspiration and conservation action that I imagine the Copelands envisioned

Staff in the trial garden, where plants are evaluated not only for horticultural data, but pollinator interest.

when they first conceived of the idea to one day welcome the public into their home and gardens.

In 2021, the five-year trial of smooth hydrangea was complete and the results were in. The top-performing hydrangeas were identified, and pollinator counts were tallied. The pollinator data confirmed what could be readily observed when the plants were in bloom each year. Insects overwhelmingly preferred lacecap hydrangeas over mopheads. That is not to say that all mopheads are completely devoid of pollinator value. In fact, some attracted a reasonable number of insects. The mophead that attracted the most insects in the trial was *Hydrangea arborescens* 'NCHA2' (Invincibelle® Spirit II) which, maybe not surprisingly, produced a greater proportion of accessible fertile flowers than other mopheads. While some compromises exist where you can have both the mophead aesthetic as well as some pollinator value no mophead hydrangea received enough pollinator visits to be directly compared to any of the lacecaps. Interestingly, the hydrangea with the lowest number of pollinator visits was *Hydrangea arborescens* 'Hayes Starburst'. This cultivar exhibits mophead inflorescences but is an extreme case of genetic variation within the species. While most mophead smooth hydrangeas produce a reduced number of fertile flowers, *Hydrangea arborescens* 'Haye's Starburst' produced no observable fertile flowers. No fertile flowers mean no pollen or nectar and therefore no pollinator benefits. This lack of pollinator value was directly reflected in the low pollinator count. Interestingly, there were three exceptions that broke the rule that lacecaps are better than mopheads for pollinators: *Hydrangea arborescens* 'Riven Lace', *Hydrangea arborescens* 'Emerald Lace', and *Hydrangea arborescens* 'Green Dragon'. These are relatively compact plants with lacecap inflorescences and distinctive dissected foliage. These three cultivars are so similar that it is widely believed that they are actually the same, genetically identical plant that was named and introduced into the horticultural trade on three separate occasions. Their inability to attract insect pollinators remains a mystery, but could be attributed to several factors, including the possibility that these cultivars do not offer the same quality or abundance of nectar or pollen as other lacecaps hydrangeas in the trial.

From a purely ornamental perspective, most of the nineteen smooth hydrangea cultivars grown in shade performed better than the specimens in full sun. The primary reason for this is that shade-grown plants avoided issues such as foliar and floral burn as

> We observed adult wasps excavating the spongy, pith-filled cores of recently pruned stems.

well as premature defoliation. Inflorescences of the hydrangeas grown in shade retained their form for months after the fertile flowers had finished blooming in July, and aged from white to attractive shades of lime green. *Hydrangea radiata* and its cultivars struggled the most when grown in full sun, particularly during the heat of the summer. These were always the first to show signs of heat and drought stress and were the first to start dropping leaves. This species is best reserved for use in woodland edges and shade plantings in the mid-Atlantic region. At Mt. Cuba Center, *Hydrangea radiata* is grown to perfection in the shady naturalistic gardens where the silvery undersides of the leaves add movement and interest to the landscape and their lacecap inflorescences attract insect pollinators in droves.

To my surprise, a handful of pink flowering hydrangeas performed exceptionally well in full sun, even better than in shade, including *Hydrangea arborescens* 'NCHA2' (Invincibelle® Spirit II) and *Hydrangea arborescens* 'NCHA4' (Incrediball® Blush). These two cultivars can be successfully sited in full sun locations (six or more hours of sun a day) in the region surrounding Mt. Cuba Center if they are planted in moisture-retentive but well-drained soils. Good soil moisture remains an essential component for successful cultivation of any of the smooth hydrangeas planted in full sun or near full sun conditions.

The cutback comparison conducted over three seasons revealed some interesting trends. There was a slight delay in bloom (generally one to two weeks) in cutback plants and fewer but larger inflorescences. This increased diameter of the inflorescences can be attributed to a return to a more vigorous juvenile state in the cutback shrubs. On average the inflorescence increase was around thirty percent, while some examples increased between fifty to eighty percent in diameter. For some plants this effect was particularly noticeable especially if the inflorescences produced on a non-cutback plant were already of substantial size. For example, the cut back version of *Hydrangea arborescens* 'Haas' Halo', which produced the largest inflorescences (8") of the trial on the control plants, produced a dramatic display of flower heads that were nearly a foot across. Cutback hydrangeas also formed a more compact habit in many cases. Some exceptions to this rule were compact cultivars such as *Hydrangea arborescens* 'NCHA5' (Invincibelle® Wee White) and *Hydrangea arborescens* 'NCHA3' (Invincibelle® Ruby) where there were few discernable differences between cutback and control plants. One unexpected effect of the cutback study was that cutback plants had improved sun tolerance. Not only might the cutback plants have had more efficient water-transporting stems, but their established root systems were supporting fewer water-demanding leaves compared to the controls. However, I would not recommend annual heavy pruning to increase sun tolerance over the long run or to make larger plants permanently more accessible to smaller planting spaces. The best practice is to select the right cultivar for the right garden location based on the ultimate size of the unpruned plants and the goals of the gardener. I recommend a more restrained approach to pruning, where only a handful of the oldest stems are removed on a yearly basis, to maintain some juvenile vigor in your hydrangeas.

One unexpected but welcome benefit of hydrangea pruning in the trial garden was the observation of square-headed wasps (Crabronidae) using the pithy stems as a nesting site. On several occasions we observed adult wasps excavating the spongy, pith-filled cores of recently pruned stems. Once the cavity had been established, the adult wasp could be seen placing paralyzed flies in the hollowed-out stems for its larvae to feed on. The chambers were then sealed, protecting the developing larvae within.

Growth under shade provides comparative horticultural data for the variety of cultivars trialled at Mt. Cuba Center.

The larva eventually pupate, and emerge the following spring as adult wasps. Perhaps this observation would inspire people to tolerate and even embrace some dead wood in their shrubs if they knew what a benefit they could potentially be to wildlife. However, if spring pruning is required, it is still feasible to prune out full stems even if they have been colonized without interrupting wasp's life cycle. The discarded stems can be placed intact somewhere to allow emergence to occur later that year. In addition, there is an opportunity to further utilize the pruned stems by simply cutting them to lengths of eight inches to a foot and the bundling the stems together. These makeshift bee nesting sites will only further amplify the bee and wasp habitat in your landscape by using raw materials provided by your hydrangeas. In addition, *Hydrangea arborescens* is the larval host plant for the hydrangea sphinx moth and the hydrangea leaftier moth, although neither species was observed in the trial.

Nine cultivars of smooth hydrangea were identified as top performers, and the highest rated plant of all was indeed *Hydrangea arborescens* 'Haas' Halo'. This cultivar, besides being my personal favorite smooth hydrangea, offers the perfect combination of horticultural merit and ecological value. This exemplary form of smooth hydrangea was originally selected by Frederick Ray in 2008, plantsman and former Delaware Valley College horticulture professor, from the Pennsylvania garden of Joan Haas. It was chosen for its upright, vigorous growth, and for its lacecap flower heads, upwards of eight inches in diameter, that display a greater number of sterile flowers around the perimeter than those of typical *Hydrangea arborescens*. A comparable, but decidedly more obscure, selection called *Hydrangea arborescens* 'Mary Nell' made the top performer list as well. It too produces abnormally large lacecap inflorescences, distinguished by a double ring of sterile flowers around the perimeter of each flower head. *Hydrangea arborescens* 'Mary Nell' was selected and named by Joseph McDaniel, who also introduced *Hydrangea arborescens* 'Annabelle' in the 1960s. Unfortunately, *Hydrangea arborescens* 'Mary Nell' is rarely commercially available despite its substantial garden and wildlife value. Two more lacecap cultivars made the top performer list. *Hydrangea arborescens* 'Dardom' (White Dome®) is an older cultivar originally selected in Belgium in 1997 and introduced by Proven Winners® in the early 2000s. It boasts large lacecap inflorescences and attracted the highest numbers of pollinators of any hydrangea in the trial. *Hydrangea arborescens* 'Total Eclipse' is a vigorous, slightly more compact, and earlier-blooming selection of the species made by Jim Pyler of Natural Landscapes Nursery in West Grove, Pennsylvania. This cultivar also attracted the third most pollinators of any hydrangea in the evaluation.

The remaining five top-performing hydrangeas from the trial produce mophead inflorescences. While these plants may not have the pollinator value offered by the lacecap top performers, they are still highly recommended from an ornamental perspective for gardens of the mid-Atlantic. *Hydrangea arborescens* 'Abetwo' (Incrediball®) and *Hydrangea arborescens* 'Bounty' are two white-blooming mopheads that offer excellent alternatives to *Hydrangea arborescens* 'Annabelle' and *Hydrangea arborescens* 'Grandiflora'. Each features the classic hydrangea aesthetic that gardeners have valued for more than a century, but improve on their predecessors with sturdy stems that are resistant to flopping. *Hydrangea* 'SMNHALR' (Lime Rickey®), a unique mophead hydrangea from Spring Meadow Nursery, displays undeniably attractive, lime-green inflorescences in mid-June that are quickly followed by raspberry-colored fertile flowers later in the month. The sterile flowers rapidly fade to alabaster before reverting to their former green color as the fertile flowers complete their bloom. Last but not least are *Hydrangea arborescens* 'NCHA4' (Incrediball® Blush) and *Hydrangea arborescens* 'NCHA2' (Invincibelle® Spirit II). Both cultivars are some of the finest examples of the cutting-edge plant breeding that continues to push the boundaries of what is thought possible with hydrangea, redbuds, and dogwoods amongst many other woody plant genera coming from North Carolina State University and Thomas Ranney. These two cultivars feature attractive pink mophead inflorescences that are well supported by sturdy stems. *Hydrangea arborescens* 'NCHA4' (Incrediball® Blush) is a great option for smaller landscapes thanks to its semi-compact habit of four to five feet in height and width, while *Hydrangea arborescens* 'NCHA2' (Invincibelle® Spirit II) eventually forms a much larger plant reaching six feet in height and eight feet in width. For more information on the top performing smooth hydrangeas from Mt. Cuba Center's latest trial, visit mtcubacenter.org/research/trial-garden/.

For me, the smooth hydrangea trial represents a turning point in my personal gardening journey which, just like the garden itself, is constantly evolving and is never truly complete. I went from largely looking at plants as a decoration for my home landscape, an admittedly narrow view, to choosing plants not just for me but for wildlife that I can support and provide refuge for in my garden. Seeing the surge in insects and birds and other wildlife at my home, a trend which I would like to think directly correlates to my native plant choices, has been an incredibly rewarding experience, and is so much more than just cultivating a place of objective beauty. It provides me with a purpose, the same purpose that the Copelands had when they envisioned the future of their property that would eventually become Mt. Cuba Center. Thanks to this trial, I have a newfound appreciation for the *Hydrangea arborescens* 'Grandiflora' that still resides at my home in Kennett Square, although my future hydrangea selections will be made for the benefit of pollinators. My personal journey into the world on native hydrangeas has not concluded with this trial, and in fact will only be expanded upon with Mt. Cuba Center's newly planted evaluation of oakleaf hydrangeas. This trial will be unique in that, for the first time, we are trialing a single species and comparing its many cultivated forms. *Hydrangea quercifolia* has many seasons of interest: it is well known for the oak-shaped leaves for which it is named, white to pink panicle inflorescences in summer, incredible burgundy fall color, and exfoliating cinnamon-colored bark that can be admired during winter months. The trial will assess cultivars that are tried-and-true garden classics as well as a handful of newcomers to the horticultural market. The oakleaf hydrangea trial will be sited in full sun; however, most of the subjects will also be grown under our shade structure for comparison. This will be an interesting trial for observing pollinator preference, because the percentage of fertile flowers per inflorescence in cultivated forms and selections of this species is quite variable. Oakleaf hydrangeas are one of my all-time favorite shrubs and I know I am in for more horticultural and ecological inspiration in the trial garden at Mt. Cuba Center before the results are of this latest trial are published in 2027.

SAM HOADLEY *is the Manager of Horticultural Research at Mt. Cuba Center where he evaluates native plant species and cultivars for their horticultural qualities and ecological value. Sam earned a degree in Sustainable Landscape Horticulture from the University of Vermont.*

TREE TIME

Pinus krempfii Does Battle

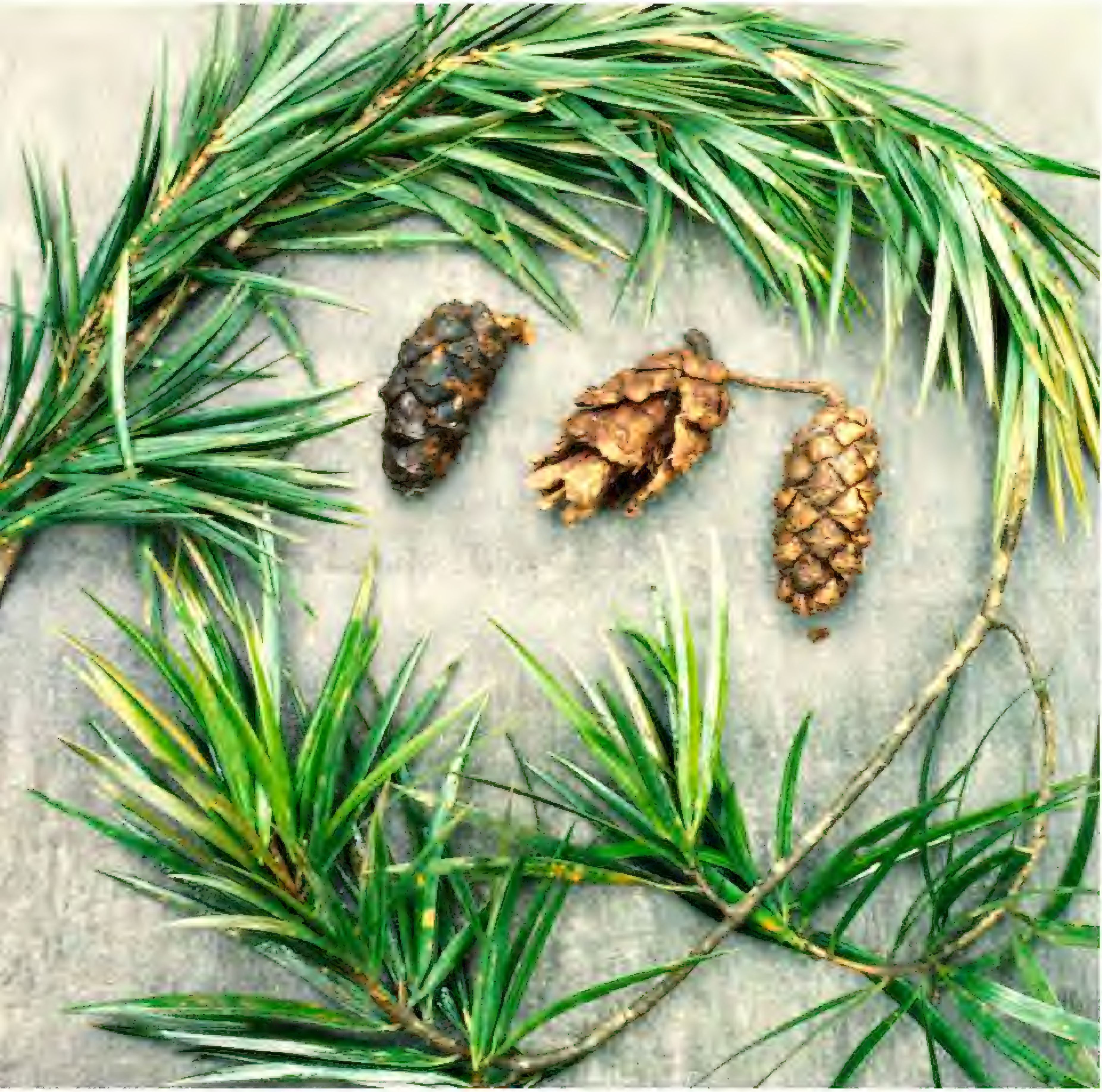
By Rob Nicholson

> All the plants of a given country are at war one with another. The first who establish themselves by chance in a particular spot tend, by the mere occupancy of space, to exclude other species—the greater choke the smaller, the longest-lived replace those which last for a shorter period, the more prolific gradually make themselves masters of the ground, which species multiplying more slowly would otherwise fill.
>
> —Augustin Pyramus de Candolle 1820

Writing more than a decade before Charles Darwin embarked on the *Beagle,* Swiss botanist Augustin Pyramus de Candolle (1778–1841) foreshadowed the idea of the survival of the fittest when he wrote of the ecological competition between plants, a competition with inevitable winners and losers. Over geological history, the groups of plants that cloak the earth have shifted dramatically with changes in climate, and as new groups of plants evolved and entered the battle for territorial supremacy. Between the Devonian and early Cretaceous periods (about 380 to 125 million years before present), the world's flora saw the rise and dominance of gymnosperms: conifers, cycads, ginkgos, and others. In the early Cretaceous, angiosperms, or flowering plants, began to evolve, proliferating into the hundreds of families, now some ninety percent of all plant species, which now dominate vast areas of the planet. Gymnosperms (roughly one percent of extant plant species) surrendered huge expanses of land and were pushed to high altitudes, the boreal region, or into cohabitation with the new "masters of the ground," flowering plants.

Modern ecologists shun the vivid language of "the war between the plants," couching this battle in terms like "sequential clade competition" and the "active displacement hypothesis." But with global warming, the shrinking of the boreal forest and mountaintop refuges will only accelerate the gymnosperms' loss of territory. This largely human-induced change may be more rapid than any yet withstood by the group.

Pinus krempfii foliage and cones collected by the author, showing the tree's distinctive leaves. *Photograph by Rob Nicholson*



Ebb and Flow

The largest family in the gymnosperms, Pinaceae, the Pine family, includes 232 species, with 119 described as pines in the genus *Pinus*. Of these true pines, the IUCN lists nineteen as falling in the most dire categories: vulnerable, endangered, or critically endangered. *Pinus* has one of the widest natural ranges of any genus of trees on the planet, both in terms of latitudinal distribution and altitudinal distribution, and is also one of the most widely planted of trees. Predominantly native to the Northern Hemisphere, pines grow from 72 degrees North latitude in Siberia to just below the equator in the mountains of Sumatra, and range in elevation from coastal species like *Pinus rigida* and *Pinus banksiana* to pines in Mexico and the Himalayas growing well above 10,000 feet elevation.

Still one of the most poorly known pines, *Pinus krempfii* of Vietnam is also highly unusual. Its broad, flat leaves can measure 12 mm wide over a length of 10 cm, unlike the more familiar thin needles of species like white pine, *Pinus strobus*. In the tropical forests it inhabits, it grows to be a colossal tree, towering over the surrounding flora. The species was described in 1921 by the French botanist M. Krempf, in the Nha Trang vicinity, where it is no longer found. Never widely collected, its specimens in cultivation number in single digits outside of Vietnam. A tropical holdout in the war of the plants, *P. krempfii* isn't faring as well in the competition for collection.

Prior to the discovery of Krempf's pine, paleobotanists had recorded finds of fossils of a broad-needled Pinaceae. The current climatic conditions where *Pinus krempfii* is found are warm, humid, and equitable. These conditions prevailed during the Paleocene Epoch (56-66 MYA), during which time a 'boreotropical flora' dominated much of the middle latitudes. Gymnosperms such as *Glyptostrobus, Sequoia* and *Taxodium* were components of this flora, and, since this epoch, their ranges have been severely contracted. This would have been a period in which *P. krempfii* or its precursors may have had a far wider range. A diminution of favorable conditions for the boreotropical flora during the Eocene (34-56 MYA), coupled with increasing competition from angiosperms, may have severely reduced the potential range for a conifer adapted to mild conditions. Two fossil discoveries in 2021 in Northern Thailand and Yunnan relate to *P. krempfii*, and show it once had a greater range. Like *Metasequoia glyptostroboides* (dawn redwood), it now exists in a highly restricted area. This perhaps adds *P. krempfii* to the list of "living fossils," such as dawn redwood and Wollemi pine—plants that were known as fossils before they were linked to extant populations.

Dr. Tim Brodribb, a former Fellow at the Harvard Forest, has visited the wild stands of *Pinus krempfii,* and his 2008 report with Dr. Taylor Field is to my mind the best recent ecological paper. He argues that Krempf's pine behaves more like a tropical gymnosperm *Podocarpus,* noting that the tree "shows photosynthetic, hydraulic and anatomical characteristics more akin to a southern hemisphere podocarp than a pine tree," with leaves that show a "striking convergence with the flattened leaves of rainforest Podocarpaceae" as well. But what really catches my eye is Brodribb's profoundly de Candollean view of the species. Krempf's pine, he notes, offers the first evidence that "*Pinus* has the physiological (and anatomical) capabilities to invade equatorial evergreen forest. The question remains whether the evolution of broad leaves and shade tolerance is a recent development, representing a new southward invasion of the genus, or alternatively the remnant of an ancient and unsuccessful invasion." Whether recent or ancient, invasion is a constant.

Collecting for the Smith College Conservatory in the autumn of 1998, I teamed with Dr. Shu-Miaw Chaw of Taipei's Academy of Sciences to collect rare conifers of Taiwan and Vietnam. We wished to bring into cultivation many rare and endangered species for future research purposes, and Dr. Chaw was to collect DNA samples of conifers for her work on the evolution and phylogeny of gymnosperms. Our research team was to have an extraordinarily successful trip, collecting such rarities as *Amentotaxus formosana, Cephalotaxus wilsoniana, Cephalotaxus mannii, Calocedrus macrolepis, Taxus wallichiana, Keteleeria evelyniana, Podocarpus nerifolius*—and one of our primary goals, *Pinus krempfii*.

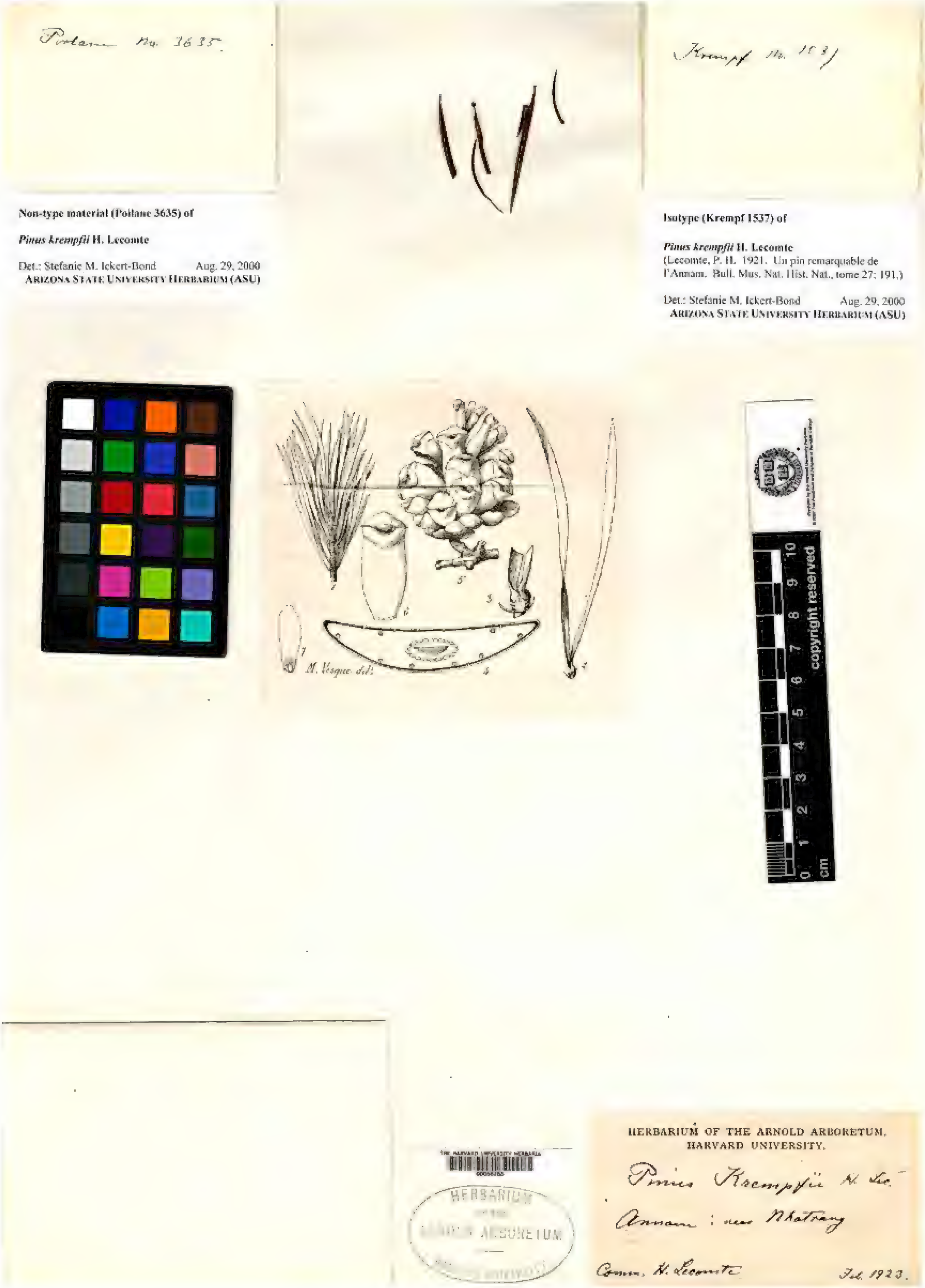
Once in Hanoi, we began our journey with a courtesy call to Dr. Le Thi Xuan, the head of the Biotechnology Institute, whom we knew from prior collecting trips for *Taxus*/Taxol research. She had been instrumental in linking us to Dr. Tran Ngoc Ninh, a capable field botanist and expert in the Rubiaceae. As time was tight due to our early flight, we only had time to maneuver quickly through local alleyways to her home and take tea. Our old friend was ill, struggled to move and speak, but insisted on extending hospitality to us. We socialized and exchanged gifts and then briskly headed to the airport for the flight south.

As we were leaving, she pulled me aside. "Be careful in the Đà Lạt Forest," she whispered. "It is full of danger."

"What kind of danger?" I replied. "Two-legged or four-legged?"

"Danger of every kind," she replied, in a grace note worthy of Joseph Conrad.

After two flights from Hanoi, we landed at Đà Lạt airport and drove upward into the hills, where the city lay, at 4900 feet (1500 m), home to over 100,000 people. A balmy summer capital for many of the regimes that have ruled Vietnam, Đà Lạt boasts a miniature Eiffel Tower as a souvenir of occupation by the French, along with the fine French bread and French roast coffee that can be found in the cafes. At the southern terminus of the Annamite range of mountains, one of the southernmost pieces of high ground on the Asian landmass, a number of conifer genera reach the southernmost extent of their ranges. Isolated here for millions of years, they may possess unusual genetic characteristics.


Poilane no. 3635.
Krempf no. 1537
Non-type material (Poilane 3635) of
Pinus krempfii H. Lecomte
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ARIZONA STATE UNIVERSITY HERBARIUM (ASU)
Isotype (Krempf 1537) of
Pinus krempfii H. Lecomte
(Lecomte, P. H. 1921. Un pin remarquable de l'Annam. Bull. Mus. Nat. Hist. Nat., tome 27: 191.)
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HERBARIUM OF THE ARNOLD ARBORETUM
HERBARIUM OF THE ARNOLD ARBORETUM, HARVARD UNIVERSITY.
Pinus Krempfii H. Lec.
Annam: near Nhatrang
Comm. H. Lecomte Feb. 1923.

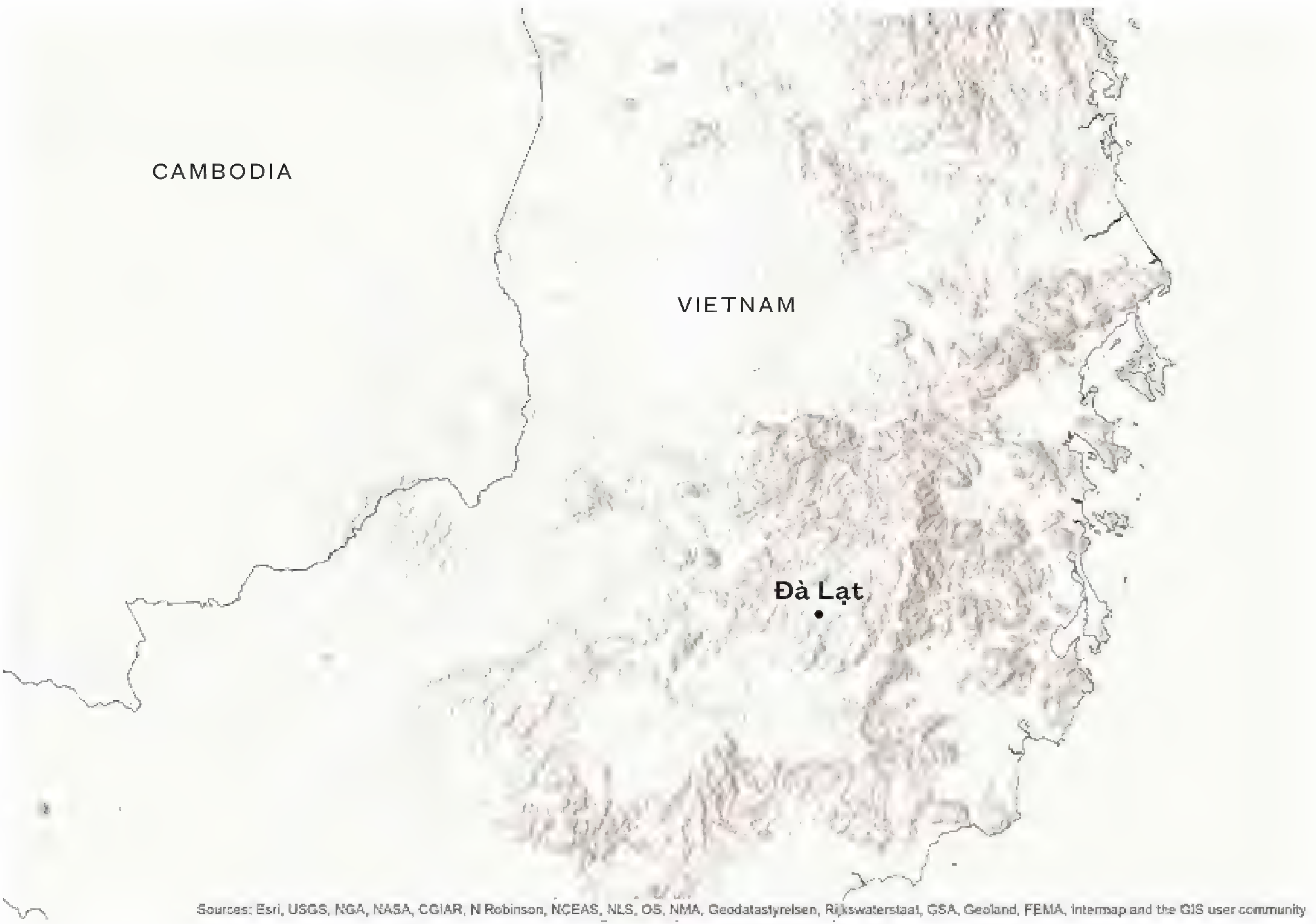
The herbarium specimen for Krempf's pine, mounted with "non-type material," offers scant documentation. *Courtesy of President and Fellows of Harvard College*

The author in the field, in the mountains of Vietnam.
Photograph by Dr. Melvin Shemluck

We stayed at the Biological Institute, located in a former Catholic monastery on the town's outskirts. It was built by Catholic monks in 1950 but lost to the Communist takeover in 1954. Despite the apparent low budget, the institute had a tissue culture lab and was involved in conserving the many endemic plant and animal species of the region. In the small nursery outside grew a number of conifer species we sought, including *Taxus wallichiana, Dacrydium elatum, Fokenia hodginsii,* and *Podocarpus neriifolius*. The former Director of the Arnold Arboretum, Dr. Peter Ashton, who had been to Đà Lạt, had informed me that a specimen of *Pinus krempfii* also grew nearby. In Công Ty Park on the outskirts of town, we found a *Keteleeria evelyniana* in cone, a member of the pine family, which grows well in our southern states but is poorly known horticulturally. No more than fifty feet from it, we found our prize: a specimen of Krempf's pine. Looking like a broad-leafed *Podocarpus* from only ten feet away, though on close examination it held its new "candles" like a pine, and smelled like a pine when crushed. We happily collected needles and herbarium sheets.

The next day we drove to Xuan Tho, a section of Đà Lạt, to see a stand of native *Taxus wallichiana,* the Himalayan yew, and to collect cuttings for the *Taxus* collection at Smith College, a collection used extensively for anti-cancer research. It was the height of Vietnam's coffee boom, and the whole area showed a recent conversion to plantations, as Viet coffee gained in stature among gourmets. At 1420 meters, we walked down a slope toward a small stream bed. *Nepenthes smilesii,* a vinelike pitcher plant, was growing among the grassy understory of this pine forest. Only two yews remained, one a substantial specimen, eighty feet high with a basal diameter of four to five feet. On our return to the institute, we stopped at the home of a local plant collector, a forester, in whose lathe house grew numerous orchids alongside a locally-collected specimen of *Cephalotaxus mannii,* a gymnosperm within the Cephalotaxaceae, from which he generously provided us cuttings.

After a hard night's rain, the dawn broke clear, and we loaded our war-vintage Russian jeep and headed out of town, driving past schoolchildren trudging down the road in neat blue uniforms. We



Sources: Esri, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

Đà Lạt lies above 1500 meters at the southern end of the Annamite range, an altitude that helps make it a southerly refugium for pines. *Map by Kyle Port*

wove through a quilt of grassy pinelands and carefully tended, productive family farms. Nine kilometers from the institute, we halted beside a roadside grove of *Keteleeria evelyniana* that had recently suffered through a forest fire. Plants from the collection we made there currently grow with Dr. Jason Smith of Florida State University. Another species, *Keteleeria roulettii,* had been reported as endemic to the Đà Lạt area, based on the observation of longer needles. But from our observations of *K. evelyniana,* it was clear that fire had caused a series of new shoots to regenerate longer juvenile foliage, and this character was probably the basis of a false "new" species. It is no longer recognized.

We continued on the muddy red-orange road upward through a pine savannah, very similar to the longleaf pine forests of southern Georgia, into an unpopulated and relatively undisturbed piece of geography. About twenty-eight kilometers from the institute, we stopped at 1700 meters altitude in the area known as Lán Chanh. Putting our packs to our backs, we marched to the crest of a small hill. Looking down into the valley, we could see a drastic change in the vegetation: the piney grassland became a primeval evergreen forest, moist, dark, and lush. Rising above it all, a towering example of the pine we had come so far to see and collect, *Pinus krempfii.* Rather than having a spire-like habit, this forest giant had a broad crown, more like an oak than any pine I could remember seeing.

We eased downslope toward the sounds of birds trilling and a river's flow, crossing a transition zone so narrow we felt as though we had stepped through a glass wall into a terrarium. Suddenly we trod upon a soft spongy humus soil dotted with ferns and seedlings of the evergreen trees around us. So many primitive angiosperms were present—*Magnolia* of the Magnoliaceae, *Illicium* of the Illiciaceae, *Sacandra* of the Chloranthaceae—it seemed a forest undisturbed since the Cretaceous era. Orchids were common, having fallen from the branches above, species of *Dendrobium, Bulbophyllum* and *Epigeneium* that would be precious to any orchid fancier. We made our way to the large pine we had seen from the hilltop, which proved a tree of mythic proportions: about 120 feet high with a trunk circumference of eighteen feet, the first branch at a height of seventy-five feet. Climbing the tree to harvest cones would have been unreasonably risky without climbing equipment, so we had to forage for what we could find on the ground.

Our party of five took to combing the forest floor, looking for fallen cones from prior years that might still harbor a seed or two, or for seedlings and saplings we might dig up. At one point I searched farther away from the party only to be cautioned by Dr. Tran to come back into the fold. "There are tigers," he warned. We found 4 younger trees and about twenty seedlings to bring to our respective institutes. The leaves were so unlike any I had ever seen, curving blades 4 mm wide by 6 cm long, held in pairs. Cones that we found in the forest duff were easily recognized as pine. We also collected cuttings of *Podocarpus neriifolius,* along with some of the epiphytic orchids fallen from their perches above, and a smattering of ferns and seed.

Our Vietnamese colleagues seemed intent on getting out of the forest as quickly as possible, and counseled against crossing the valley to look for more trees. I recollected Dr. Xuan's warning in Hanoi, and was relieved to think that we had avoided any peril beyond the usual rigors of the field. In any case, I already had collected a cache of rarities for our Smith College conservatory, and we had precious DNA samples for genetic work. We rose out of the ravine, over the grassy slopes and down to our waiting vehicle. We lunched at the side of the road, fine French-style baguettes, local fruit and imported soft cheese. Our success fueled our good mood and we sat on the side of the road, talking about our various plant specialties and favorite species. I glanced down at my feet and saw in the road's gutter a weathered bullet casing, American made, a probable relict from the war that once tore both nations apart. It was my final collection of the day.

The few seedlings we brought out seemed to languish in the heat of our New England summer, and eventually died. Despite numerous hormone treatments, none of our cuttings rooted (though this is typical for pines). Other than the lonely plant at the Cong Ty Park in Đà Lạt, the only plant I could find in cultivation is held in the conservatory at Royal Botanic Garden Edinburgh. Groves of Krempf's pine also are found within the boundaries of the Bidoup Nui Ba National Park, established in 2004, though their remoteness may make them susceptible to illegal timber poaching. *Pinus krempfii* remains aloof, distant and beckoning still. Given its great height, future collectors may need collection equipment like that used for *Sequoiadendron:* a bow and stringed arrow followed by ascension gear, with skilled arborists acquiring a supply of seed for ex-situ work.

Growing ex-situ specimens outside native ranges requires a combination of factors: the correct climate conditions (whether in a conservatory or outside), a long-term infrastructure of skilled horticulturists, and institutional will. The correct climate conditions would seem to be the biggest stumbling block for Krempf's pine, as it grows in montane tropical or cloud-forest conditions without extremes of cold or heat. Its hardiness is not known. Some of the mildest areas of the California coast and upper altitudes in Puerto Rico may serve as potential US sites, though hurricanes would be a factor in Puerto Rico. But as was shown with *Metasequoia,* it can be a fool's game to make hardiness assumptions based on a current restricted population range.

As elsewhere, the war of the trees continues in Vietnam, though thankfully the wars of the humans there have subsided. For all its rarity, *Pinus krempfii* is a magnificent holdout against angiosperm domination, one of the most amazing species I have ever seen in a long career collecting plants. In discussing local politics, Dr. Xuan had once told me, "In Vietnam, nothing is possible but everything is possible"; the latter part of that truism seems to apply to the flora as well.

The author dedicates this piece to the memory of Dr. Melvin Shemluck, who caught him when he fell from trees.

OVER A 43-YEAR CAREER, ROB NICHOLSON *worked for three New England botanic gardens, undertaking over thirty plant collecting expeditions for collections building, conservation, and medical and botanical research, and making 1,920 wild collections for the Arnold Arboretum.*

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Two Poems

By Jessica Fjeld

Early

Early I descend the stairs like a child's newly-acquired marionette
No part in predictable relation to the others
In the kitchen on the top shelf is a cardboard bankers box
Full of boiling water
Good
The lilac's leaves all withered but for months it has had a hundred green
little buds, firm little pregnancies at the tip of each branch
I am watching them daily to gauge their intentions
I think you should find it surprising that given the time we spend on our
feet, it's so difficult to learn to stand on our hands

How the ground presses up

The cement is compromised, full of hope and sand
I tell the children it's a bunker   due to the bunk beds

They want to show the beds to visitors but instead
we teach them moral rectitude, screaming,

subsisting on sugar and edible species of fungus
Their teeth sink into cake like

gravity sinks into the snow laying thick on the mountainside
The mutinous avalanche turns the trees upside down

but the trees are prepared
Their roots and branches mirrored   in all relevant respects

JESSICA FJELD *is the author of* Redwork *(2018) and the chapbooks* The Tide *(2010) and* On animate life *(2006), for which she received the Poetry Society of America's Chapbook Fellowship. Also an attorney and academic, Fjeld is the Assistant Director of the Harvard Law School Cyberlaw Clinic at the Berkman Klein Center for Internet & Society, where she focuses on supporting the work of creatives, archivists, and human rights defenders as that work intersects with emerging technology. She lives with her family in Somerville, MA.*

HISTORY OF LANDSCAPE

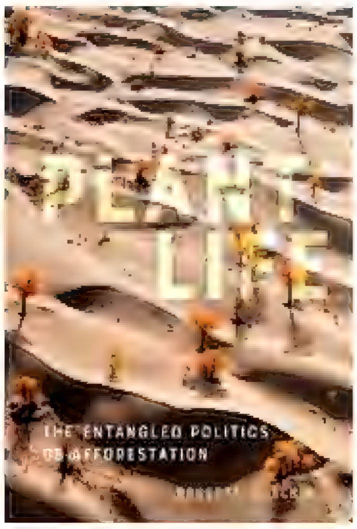
The Timber Culture Act

By Rosetta S. Elkin

The Timber Culture Act (1873) was a radical means to secure resources in otherwise treeless environments. Its stated claim provided entry "for the cultivation of timber which are prairie lands or other lands devoid of timber."[1] Its passing mobilized the protocols and promises of affidavit to deed land across the prairie states. The act was followed by land entries and land patents, the final steps in securing land that had already been peopled for thousands of years by hundreds of Native American tribes.[2] Nebraska—a prairie state—took the lead in land entry numbers, tallies, and acres, which frames the itinerary of tree planting as a form of land tenure predicated on afforestation because Nebraska is principally a dry prairie grassland.[3] Therefore, the Timber Culture Act sanctioned the substitution and deletion of dryland ecology, in this case both the extant prairie biome and the skillful cultivation of its inhabitants. A quick review of the associated institutional language makes evident the use of authority, hinged on administrative tasks. It further implicates the individual farmer as a developer, invested in the act of swapping thick grassy cover for individual tree units in order to establish an enterprise.

Where 160 acres are taken, at least five must be plowed within one year from date of entry. The following, or second year, said five acres must be actually cultivated to crops or otherwise, and another five acres must be plowed. The third year the first five acres must be planted to trees, tree seeds or cuttings, and the second five acres actually cultivated to crop or otherwise. The fourth year, the second five acres must be planted to trees, tree seeds or cuttings, making, at the end of the fourth year, ten acres thus planted to trees.[4]

A "tree claim" could be filled in by anyone, and in return no more than 160 acres was acquired, with the specification that 40 acres of the claim must be tree planted, an effective means to ensure settlement. According to one claimant, "the section of land specified in my said application is composed exclusively of prairie lands, or other lands devoid of timber; that this filing and entry is made for the cultivation of timber and that I have made said application in good faith."[5] Units coalesced local and regional affairs, advancing federal and legislative ambitions. But the cost was only refined in the fine print, which specified that no fewer than 2,700 tree units could be planted on any ten-acre block.[6] It was a staggering number that led to copious tallies, monitoring



Excerpted from chapter 4, "Confronting Treelessness," in *Plant Life: The Entangled Politics of Afforestation* by Rosetta S. Elkin. Published by the University of Minnesota Press. Copyright 2022 by the Regents of the University of Minnesota. All rights reserved.

The first artificial national forest, planted by hand across the Nebraska Sandhills. *Image from Google Earth (2016)*

programs, and the need for reportage. Each territorial procedure (survey, reportage) reinforced the hopelessness of the task: water was scarce, winds were strong, erosion seemed erratic, and the quantity of units could not be sustained.

To plow and maintain 160 acres with a mix of crops and trees was a challenge that took hold for very few claims.[7] Managing 675 living trees on each acre was akin to owning a product, and growing trees was the best way to hold onto your land and avoid the cancelation of your claim. The number of entries made under the Timber Culture Act records area in acres, although territory could only be claimed if individual tree units were calculated and submitted for approval. This kind of accounting leaves out more than it includes, marking both the beginning of afforestation-linked landscape management and the rise of incentive-based policy maladapted to drylands.

In Nebraska alone almost nine million acres were claimed under the act, but final proof was only made for trees planted across two million acres.[8] Since alterations to the land were less predictable than imagined, the gradual accumulation of expertise was necessary to further instill confidence in afforestation. The newly formed federal government certainly did not want western expansion to be deemed a failure.

Not surprisingly, this tension between success and failure required expertise, which arrived in the form of technical manuals, suitable species lists, and machinery types: the index of expertise. In the radical ecology of afforestation projects, the concept of failure is critical to the vocabulary of management, whereby catastrophe becomes a claim made by a specialist rather than a circumstance of ill-aligned biotic and climatic association. From a different angle, this means that expertise reinforces ecological projections through a series of calculated procedures rather than distinguishes, decodes, and evolves through direct experience with plant life. In fact, the plant really had nothing to do with it. Thus, failures in tallying units set the stage for the assimilation of expertise, which was equally an opportunity for the emerging business of arboriculture to become the science of forestry.

The Timber Culture Act mobilized substantial takings across drylands, revealing that trees were valued as an important natural resource before forestry emerged as a discipline. At the time, forestry was a colonial economy, a means to import and spread viable European plants across the American continent and send New World novelties back to Europe.[9] The botanical studies and the natural sciences were far too remote from the actual efforts of farming, explicated by the disparity created between increasing knowledge of plant parts in botany and the transmission of their application into common use, through horticulture. The more practical "cultures"—including the planting of trees in cities, crops for a homestead, or flowers for public display—were the domain of arboriculture, horticulture, or agriculture, for instance. Botanical studies were firmly indifferent to practical endeavors in much the same ways as farmers or ranchers are indifferent to scientific study. Botany's elevated status ensured that it did not labor, and its scientific status protected it from ever having to do so. So long as these two practices (botany and horticulture) remain entirely distinct and in organized separation, a summarized reading of plant life is multiplied into the space of physical, earthly matters.

Imagine a world of individual farmers working across vastly differentiated territories. Each effort represents a struggle to hold boundaries across a landscape without trees. Consequently, the failure to establish trees compelled professionalization. Failure was pinned on individual farmers and expertly manipulated as a means to assert more control over territory.[10] It was not attributed to the ill calibration of species, quantity or the insistence of inserting trees into a vast, treeless landscape. Rather, lands beyond the hundredth meridian look empty from the shady groves of the East Coast.

Timber and crops were needed to support a growing population, and the prairies represented a blank canvas. As a result, tree culture across the Plains was predicated on the need for protection from the harsh climatic conditions, which offered a correspondingly reduced description of the grassland biome.[11] In order to increase agricultural production by sheltering farmlands from strong winds, each belt, break, or wall represented more than local shelter, firewood, or fuel: it was an opportunity to nationalize timber. The replicable model of planting a shelterbelt catalyzes the farmer as an agent of the federal economy by suppressing indigenous practices and local acquaintance. The language of this authority eliminates conjecture through levels of survey, reportage, and authoritative lists that impress with calculation.

Of the total area (Great Plains region), some 56 percent lends itself to shelterbelt planting, about 39 percent is difficult to plant, and 5 percent is entirely unfit for planting.[12]

According to this federal explanation, there is nothing essential, intermediary, or material to constrain the accumulation of units. This description instrumentalized efforts to liberate the vacant spaces between meridians.

Settlement necessitated clearing and cutting forest to make space for cultivation, as the character of cheap nature ultimately supported expansion. Both tree planting and tree felling were exploitative regimes that consolidated control across the American continent. As we have seen, the difference was contextual; trees were cleared to make space for cultivation along the arborized East Coast, and trees were planted as pioneers moved west into the treeless prairies to cultivate land. In both cases, trees with clear human advantage were selected, while plants that grew of their own accord, or spontaneously, were overlooked and rarely stabilized in the procedures of index. It took decades of energy, planting, and felling before allegiance to the spontaneous plants was described by Charles Sprague Sargent:

> Many years ago, when I first realized the difficulty of obtaining any true knowledge of the trees in this country, I formed the plan of writing a *Silva* which should contain an account of all the species that grow spontaneously in the forests of North America.[13]

The study of trees as spontaneous organisms with indigenous characteristics was described in *The Silva of North America* (1891), a work of botanical inquiry that detailed 412 species, with reference to growth habit linked to illustrated maps that indicated distribution.[14] Most significantly, Sargent, the director of the newly established Arnold Arboretum of Harvard University, made some notes on the characteristics of wood. The breadth of Sargent's ambition is explained in the preface to the first edition, including his most pressing articulation of plant life, through engagement with "living states.":

> To be really understood, they must be studied in the forest; and therefore, since the plan of writing this *Silva* was formed, I have examined the trees of America growing in their native homes from Canada to the banks of the Rio Grande and the Mountains of Arizona, and from British Columbia to the islands of Southern Florida. I have watched many of them in gardens of this country and in those of Europe and there are now hardly half a dozen of the trees which will be described in this work which I have not seen in a living state.[15]

At the time, Sargent held the position of professor of arboriculture, which ensured that his tenure at the arboretum would be focused on applied engagement with the landscape, with "plants in a living state." Sargent valued the associations between the individual tree, and its necessary relationship with soil, climate, and human codependency. His treatise provided a careful account of spontaneous woody plants, distinguishing between rainfall patterns and elevation, factors that limit tree growth at the hundredth meridian. This is the boundary of aridity that reveals the prairies as dryland.

The variable edge is endowed with a watercolor-like transparency that emulates this bond between climate and plant life. Armed with the notes on "wood producing capacity," Sargent's treatise would go on to become the first technical forestry report of the newly created Division of Forestry in the Department of Agriculture in 1886. *The Silva of North America* elevates claims in drylands, as forestry reaches into scientific study to nurture its advance. Of note is that while the profession of forestry is confirmed in the United States in the European tradition, it expands to include planting in order to secure extractable resources. The varied institutional settings between botany as a science and forestry as a profession entangle the study of plant life in the discrepancies and difficulties reports, as forestry read gaps in the maps and botanists read their extents. Rather than carefully consider the findings of Sargent's botanical fieldwork, remote structures deployed the literal blank space of his mapping efforts as a means to recontextualize the prairies as a tree-planting endeavor, converting biomes and replacing thick, fibrous rhizomes with woody plant units.

The appropriations of forestry transformed *Silva* into an operations manual—or a masterplan—which begins to explain how vast quantities of grassland expanse and ancient reserves of pastoral acreage become the jurisdiction of federal foresters. The map was "empty," a curse of drylands the world over, but it was an opportunity for the industrious. The insertion of trees infused meaning into New World expansion in the prairie states, as demand for ownership lines and boundaries enabled land claims hinged on tree planting. Afforestation emerges as forestry (not botany) and disseminates plant life as a "tree unit," transferring knowledge of resource management to each small-hold farmer. In this way, particularly profitable and predictable plant species are endorsed over others, superimposing units on extant plant life.

New World Forest Problems

1891 PUBLISHED. *The Silva of North America* (Sargent)

1901 RENAMED. Division of Forestry becomes the Bureau of Forestry

1905 RENAMED. Bureau of Forestry becomes Forest Service

1910 PUBLISHED. *The Fight for Conservation* (Pinchot)

In the American consciousness, the origins of environmentalism are tied to the ethics of conservation, first recognized as forest conservation. The lineage of conservation, like many historic accounts, is entirely dependent on the narrator. For instance, ecological thought in America was first affirmed as plant ecology, the study of plant life in the environment. What is worth bearing in mind is that despite its significance, plant ecology did not proceed as the science of consequence in the grassland biome. Rather, forestry administered and studied the prairie formation. The reasons for this odd fragmentation of knowledge are slippery to pin down, but it is worth noting the role of Gifford Pinchot (1865–1946). Pinchot was more of a politician than a forester, and he acted as the first head of the newly established Forest Service in 1905. Under his leadership, forestry progressed from a division within the Department of Agriculture (USDA) to a separate bureau responsible for forest policy across the whole land surface of the United States. The Forest Service emerged—not coincidentally—as the nation demanded unprecedented quantities of timber for fuel and construction. Charged with a simplified problem statement, Pinchot pushed forest conservation into unchartered territory.

The influence of George Perkins Marsh (1801–82) motivated Pinchot's interest in the debates of conservation. In *Man and Nature* (1864), Marsh determined that humans were a major geologic influence, famously asserting that "man is everywhere a disturbing agent," a landmark statement in both ecological and conservation studies.[16] Marsh was neither forester nor plant ecologist but articulated an unparalleled understanding of the role of plant life in preserving the landscape, in how a plant's connection to the soil maintains the substrate and prevents or reduces erosion. According to biographer David Lowenthal, the success of Marsh's rhetoric is found in his caution concerning impending disaster, by addressing what he termed "New World" forest problems. Marsh challenged the general belief that human impact on nature was generally negligible, explicating a global tendency toward wasted natural resources. Armed with *Man and Nature*, Pinchot adopts conservation as forest policy. In a sticky exchange of authority, conservation and forestry coalesce as both ethic and science, alternatively sanctioning felling and planting trees regardless of context.

Despite Marsh's warning, the Forest Service appropriated conservation as a "solution" to forest devastation, seizing upon Marsh's warning of old-world forest decline as a motivation to enforce national policy. Conservation policy progressed through extant forests and forest plantations, as plant ecology evolved as a scientific discipline in the prairie states. Remarkably, the difference was not correlated, although ecology revealed the role of plants in forming the territory and conservation uncovered the role of human agency over the territory. Rather, conservation was annexed to the profession of forestry, authorizing the Forest Service to oversee the planting of grasslands, prairies, agricultural lots, deserts, urban centers, and high mountains, concealing their extractive procedures in the outlines of conservation.

Tree-planting projects begin to materialize in the millions of acres as the soil is planted, replanted, aplanted, seeded, fenced, and labeled. The landscape is objectified, appearing and disappearing through measurement and calculation. In this way, felling and planting develop synonymously, rendering the environmental messages of Man and Nature were translated as generalized statements with gross ecological miscalculations. For instance, the notion that tree planting would bring rain to the arid West was appropriated to encourage settlers to move to ever-dryer lands.[17] The assumed property that followed tree planting is a clever disguise for afforestation. As Lowenthal's biography verifies, Marsh's message was pillaged for such "proof" that rainfall and prosperity followed tree planting. This nexus between national forest policy and conservationist thought is repeatedly stressed in Pinchot's *The Fight for Conservation* (1910): "As a forester I am glad to believe that conservation began with forestry, and that the principles which govern the Forest Service in particular and forestry in general are also the ideas that control conservation."[18]

The fight for conservation was taken up by the Forest Service, exploiting the growing concern over forest devastation in order to plant and thus control more federal land. Tree cover emerges in the lexicon of conservation. Land, absent "cover," is manipulated into land that can potentially receive cover. Tree units add up, when acres of "cover" are procedurally converted by the practices of forestry, as tree planting is sanctioned in non-treed environments. Consider the following passage.

The crown has more to do with the life of the tree than its other parts, for the most important processes in the reproduction of the tree and the digestion of its food take place in the crown. For this reason, and because we can control its shape and size more easily and directly than that of the roots or trunk, the crown is of special interest to the forester. It is almost exclusively with the crowns that he has to deal in tending a crop of trees and preparing the way for succeeding generations. As they stand together in the forest, the crowns of trees form a broken shelter, which is usually spoken of as the leaf canopy, but which may be better called the cover.[19]

Land, absent "cover," represents millions of acres of potential federal territory. The conversion of "crown" or "leaf canopy" into "cover" had a number of spatial consequences that will be addressed further. For now, the consequences are especially poignant because the root system is set aside in the first pages. Regulators, policy makers, and the forest service administrators intentionally reduced the growing plant to standing timber. The consequence is that the federal government had no use for the nascent scholarship of grassland science or the complications of plant ecology. The hidden intelligence of rhizomatic formation could not reaffirm exploitation or capital return, one of the most fundamental reasons why canopy continues to prevail in carbon-capture calculations. This is what professional expertise does when it lays claim to fact and asserts the power of disqualification instead.

Pinchot's use of the term *cover* not only left out the aliveness of plants; it delineated the absence or presence of trees. The social implications and the negligence toward practical knowledge or public intelligence were already a form of expert persuasion upon which the profession of forestry is established: treeless lands can be conserved by planting trees. This raises another question: What are the spatial—and thus social—consequences of such abridged problem statements?

If Marsh explicated the "problems" of human action, Pinchot clarified that forestry had solutions, a defense strategy that he claims as a "virile evolution of the campaign for conservation of the nation's resources."[20] Conveniently, the solution relies on the interrelated goals of national expansion and resource extraction. By associating tree planting with conservation, Pinchot appealed to President Teddy Roosevelt, who pioneered land conservation armed with Pinchot's treatises.[21] Thus, a fragmented translation of *Man and Nature* is interpreted by statistical proof in Pinchot's *The Fight for Conservation*.

At the time of *Man and Nature's* publication, federal regulations had already secured the first Forestry Service in the federal Department of Agriculture, established a forestry program at Yale University, and set aside more than 150 national forests as reserve areas. Such policy and regulatory potency have lasting spatial repercussions. Particular to the success of forestry was the reduction of national geography to manageable units, as conservation became a capital project.[22] Thus, the terms of conservation mitigated the affiliation between planting and felling, but conservation was fortified by yield management, the precision of index. This is significant to the ways in which management and development continue to prosper through the invention of crisis.

Specification in Units

Afforestation hides in the manipulation of specifications, loudly advocating for tree planting while quietly converting biomes: cut here, fill there or fell here, plant there. The cyclical arrangement is wedged between industrial and ecological intentions, necessitating expertise in both analyzing extant lands and constructing entirely new ones. Not surprisingly, the interdependencies between forest and field mobilize the need for more and more units as a primary measure of converting biomes, or planting trees to secure timber. The forester does not deal in individual trees destined for a purpose but on masses of tree units, because the individual tree has value only as part of the whole.

At the same time that Weaver was excavating earthy workshops and painstakingly detailing the depth and intricacy of the prairie formation, the character of American expansionism was emerging in tree units, as domesticated plants balanced settlement. The accumulation and distribution of homogenous units triumphed over the diverse, interconnected, spontaneous, and multiple, preventing any expression from unscientific worlds and erasing the intimate aspects of daily life where social, cultural, environmental, and plant life mingle. Armed with an antidote to treelessness, forest policy worked its way across 170 million acres of American dryland by stabilizing a sanctioned list of tree varieties, despite the warnings that cycles that transform forest to field to plow flatten diversity and destroy soil by field wash at both an unprecedented scale and an unprecedented speed due to plow and policy. The Timber Culture Act confirmed that only the most reliable, predictable plants could be confidently inserted, so these updated lists confirmed only trees that could persist in prairie soil. To facilitate planting, the specification of tree units was linear, and in the American context catalyzed the shelterbelt typology.

Dryland shelterbelts are additive, unlike the shelterbelts in Europe or those found in the American East, which are primarily composed of remnant forest. Such belts are the residues of clearing, burning, or grading procedures. The plants that remain intact are often called hedgerows or windbreaks, and are registered vertically through a prolific, enduring accumulation of biota that remain deep in the rhizosphere. In other words, the trees, shrubs, and herbs of the former landscape are unbroken, and continue to thrive in diversity and habitat. As a network of accretive forces and biological activity, they are extremely effective at slowing erosive forces. The subtractive force of clearing land produces an increase in mounds and layers within the hedgerows, as branches and rocks are thrown into piles and endure. Each mature specimen also maintains vigorous seed banks and robust sprouting stumps.

When a plant is inserted as an individual organism, copied and pasted in neat rows, it has limited ability to produce relations in the soil. This is due to the constitution of the rhizosphere, in which a process between microorganisms, fungus, and soil biota is stratified in cooperation with other neighboring organisms. Plants, left behind with their major root systems and mycorrhizal relationships intact, continue to provide reliable growth patterns. The connection of each remnant to the soil advances the entire network, an interdependent and persistent spatial structure, which pulses through the soil. In contrast, shelterbelt protocols in drylands insert plant

Top, shelterbelt of Siberian elm in Nebraska. Bottom left, the shelterbelt is a formal typology, but displays variability as plant life adapts to soil, spacing, and resources. *Photographs courtesy USDA archives.* Bottom right, remnant shelterbelt of eastern redcedar in the Sandhills today. *Photograph by Rosetta Elkin*

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units into flattened, cleared, turned, and exposed soil. Plants—treated as objects—are forced to instigate each belowground relationship anew before any achievement can be registered aboveground.

A shelterbelt not only has behaviors, domains, and unknowns; it has a spatial geometry that often necessitates two landowners, as it straddles property lines. Further, this geometric configuration not only extends a thickened line and extrudes a height gradient; it extends the root zone in both the horizontal and vertical dimensions. The roots require irrigation, nutrition, and time in order to assert aboveground effects. As a result, local disputes escalate along with the behavior of any trees that display significant mobility, as some plants spread more quickly than others. While a shelterbelt is designed to grow in height and girth, it is certainly not expected to migrate or move. If a shelterbelt is "successful," it is only because the plant evolved persistent root morphology and reproductive capacity, a feature that cannot be rendered visible or valuated economically. Yet conflict arises if the plant is successful enough to be found encroaching beyond property lines, or into productive farmland.[23] For instance, the behavior of some woody roots will outcompete annual crops for resources such as moisture and nutrients, which makes them a nuisance to farmers. In shelterbelt culture, trees are deemed beneficial only if they provide undeviating protection, and are deemed a menace if they overcome specifications.

The correlation between additive and subtracted spatial geometry illuminates the friction between developers and their environment during this period. Tree planting in the Plains exemplified this struggle, as failure to adapt was decidedly unacceptable and un-American.[24] Resolve only increases in the space between dying and trying, a feature of most developers bent on return. But it was the lack of consensus between investments that finally led to the appeal for government support.[25] Just as the American pioneers resisted treelessness, they could not cooperate on investment between property limits. Ownership is a personal discipline, as the contested fence and neighbor relationship suitably explicates. In a large-scale planted system, these thresholds prove mutually beneficial. Yet the owner who initially broke ground, transplanted, or seeded the rows tended to be the one to water, manage, and maintain it, despite shared outcomes. Effort was the developer's investment, and resistance has the power to affect the system it endorses.

Simultaneous to the decades when professional forestry, sedentary agriculture, and public acquisition were determining the American landscape, conservation collapsed neatly into agencies, services, institutes, and organizations. Political agendas merged with development strategies through the protection or abuse of natural resources, so that access and recreation became the most salient features of the vistas, lakes, peaks, and other wonders of natural beauty.[26] Forestry lurks in the background as the landscape becomes a cultural and social construct, devoid of individual life-forms beyond the human.

The symmetrical competition between growth and yield, or materializing and subtracting, currently calculates carbon credits through additive operations and timber volume in deductive increments. At once, local populations are led to believe that "billion tree" campaigns and "great green walls" are pronouncing progress, but growth statistics and depletion metrics are isolated from accountability and context. These flip-side tactics benefit from quick rotations that leverage tree planting as a means to elevate control through yield, in a world troubled by ongoing crisis.

When dealing in units, the authority of forestation selectively neglects the less visible attributes of plant life, including individual plant behavior, symbiotic relationships, and the concealed roots and rhizomes that form and deform the soil within which biomes are produced. Because of aboveground visibility, development budgets, and technical encouragement, projects that eagerly plant trees under the rubric of afforestation continue to garner international funds and approval despite the haunting conspiracy of replacing biomes and commercializing plant life. The prowess of progress that celebrates biome conversion creates as it destroys, a central tenet of afforestation.

Like the shelter belts of the Great Plains, other large-scale tree-planting projects analyzed in Plant Life: the Entangled Politics of Afforestation*—from Africa's Sahel to China's Three Norths Shelter System—fail to treat arid lands as vital ecosystems. Elkin explores the tangled politics and often devastating ecology of these projects, and challenges us to understand landscape as living thing. For more information, visit upress.umn.edu/book-division/books/plant-life.*

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ENDNOTES:

1. The full Timber Culture Act is available in Thomas Donaldson, *The Public Domain: Its History, with Statistics* (Washington, D.C.: Government Printing Office, 1884), 1093.
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5. Donaldson, 1094; Timber Culture Act, application October 3, 1878, Individual Claimant, NB.
6. Benjamin H. Hibbard, *A History of the Public Land Policies* (Madison: University of Wisconsin Press, 1965), 422.
7. Accounts of individual claims are covered in relation to the landscape in Charles Barron McIntosh, *The Nebraska Sand Hills: The Human Landscape* (Lincoln: University of Nebraska Press, 1996).
8. Everett Newfon Dick, *Conquering the Great American Desert: Nebraska* (Lincoln: Nebraska State Historical Society, 1975).
9. Philip J. Pauly, *Fruits and Plains: The Horticultural Transformation of America* (Cambridge, Mass.: Harvard University Press, 2007).
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12. Lake States Forest Experiment Station, 7.
13. Charles Sprague Sargent, *The Silva of North America: A Description of the Trees Which Grow Naturally in North America Exclusive of Mexico* (Boston: Houghton, Mifflin, 1891), v.
14. See also Charles Sprague Sargent, *Sixteen Maps Accompanying Report on Forest Trees of North America* (Washington, D.C.: U.S. Census Office, 1884).
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19. Gifford Pinchot, *A Primer of Forestry* (Washington: Government Printing Office, 1903), 7.
20. Pinchot, *The Fight for Conservation,* iv.
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22. Lowenthal, 10–12.
23. Office of Information, U.S. Forest Service, *Prairie-Plains Region Shelterbelt Project* (Washington, D.C.: U.S. Forest Service, 1946).
24. Wilmon H. Droze, *Trees, Prairies, and People* (Denton: Texas Woman's University, 1977), 30.
25. Droze, 22.
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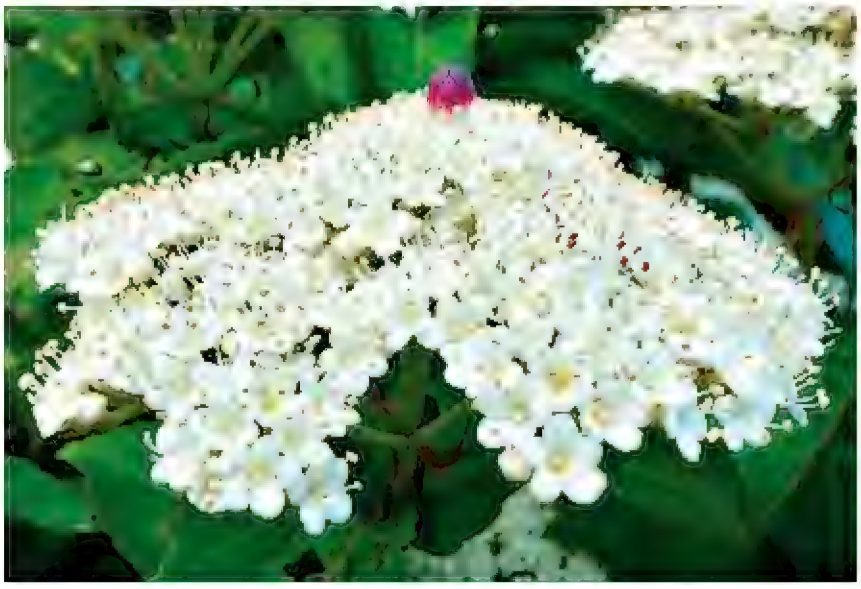
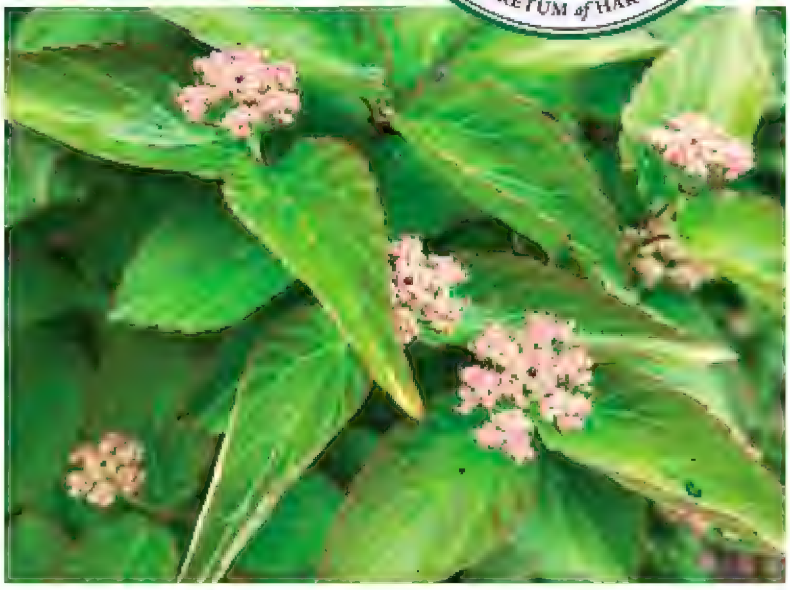
ARNOLD SELECTS

Viburnum bracteatum 'Crimson Gem'

By Tiffany Enzenbacher



Above left: Closeup of inflorescence. *Photograph by William (Ned) Friedman*

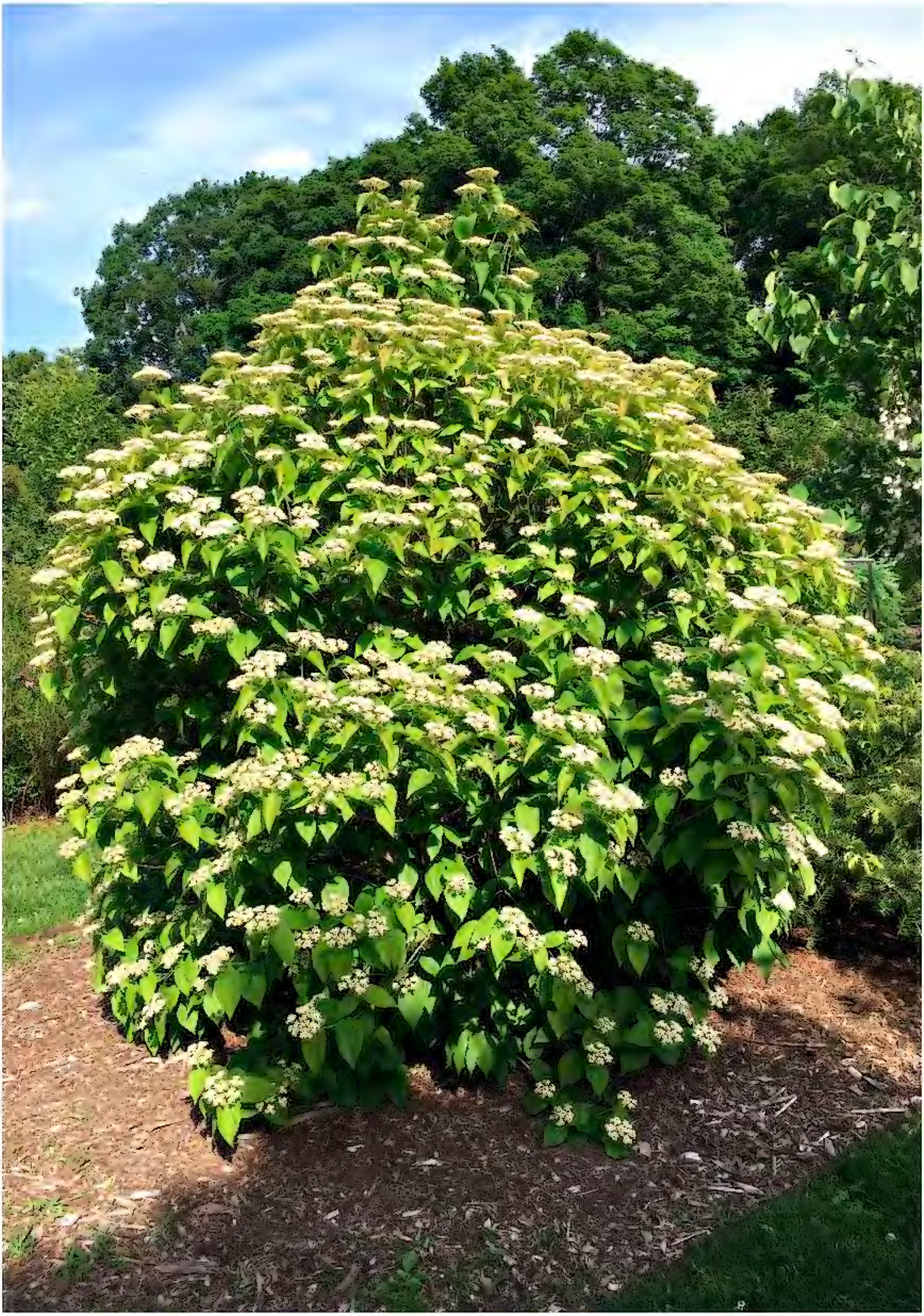


Above right: Ephemeral red foliage along margins and between leaf veins. Note that the 'gem' can be observed even before full bloom. *Photograph by Tiffany Enzenbacher*

'Crimson Gem' bracted viburnum (*Viburnum bracteatum*) is the first cultivar release from the Arnold Arboretum of Harvard University's new plant introduction program, Arnold Selects.

This bracted viburnum's one-of-a-flower was discovered over ten years ago by the Edwards Lab (then of Brown University, now of Yale) while conducting research in the Arboretum's collections, and noted by Keeper of the Living Collections, Michael Dosmann. Reading his May 2010 database field check note, one can still feel Dosmann's excitement: "inflorescences have red centers!" Indeed, blossoms have a rare sterile red floret in the center, resembling the herbaceous biennial Queen Anne's lace (*Daucus carota*). The red floret is perched above the ivory ones, literally taking center stage. These unique flat-topped cymes are held on erect pubescent, 2-inch stems that are a whopping 1 ½ to 3 inches across.

In fact, the red floret can be enjoyed even before the shrub comes into full flower, while its pearl-colored neighbors are still in bud. But the real show starts when the enchanting inflorescences open in their entirety in late May to early June, showering the shrub, and revealing the 'gem' in the center of practically every single inflorescence. Foliage is also appealing: emerging leaves have an ephemeral reddish hue, notably visible along the margins and between veins. Leaves are 2 to 4 inches long and 1 ¼ to 2 ½ inches wide, and change to dark green as the season progresses. They are ovate with acuminate tips and serrate margins. Giving the plant its common name are the four persistent, bract-like stipules



Full habit view. Note the abundance of blooms and dense late spring foliage.
Photograph by Michael S. Dosmann

***Viburnum bracteatum* 'Crimson Gem'**

HARDINESS: Zone 5 to Zone 8 (-10°F to 20°F)

HABIT: Shrub, 7 to 10 feet tall with a slightly wider spread, rounded, dense

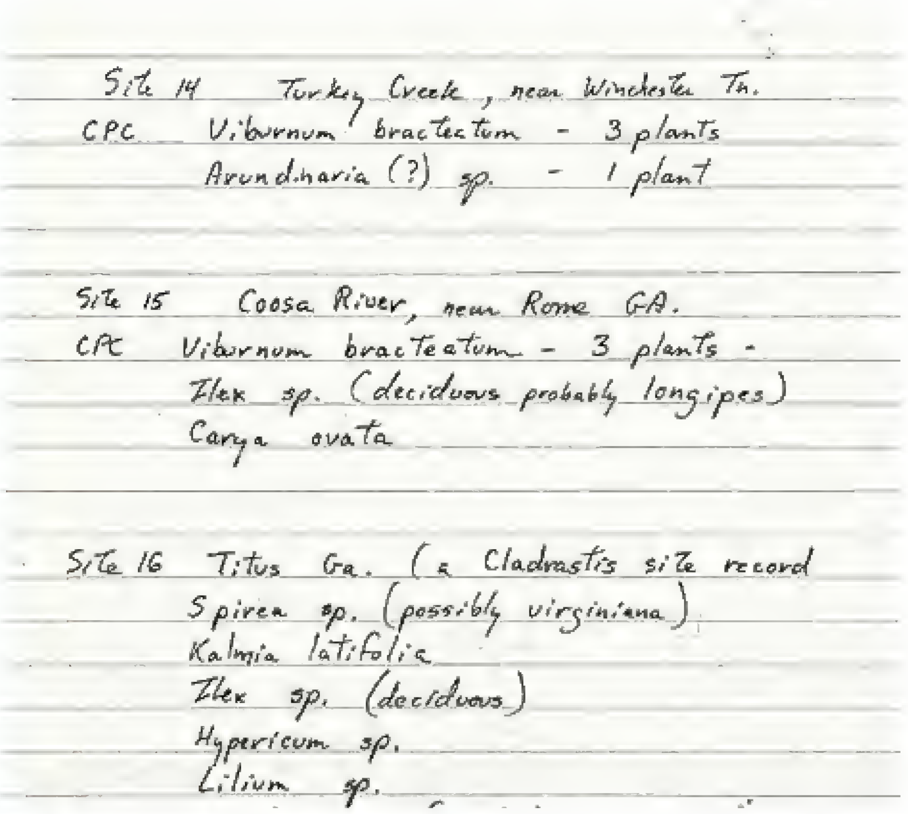
GROWTH RATE: Intermediate

SUN EXPOSURE: Full sun to part shade

SOIL CONDITIONS: Moist, well-drained, alkaline, adaptable

SEASONS OF INTEREST: Spring and autumn

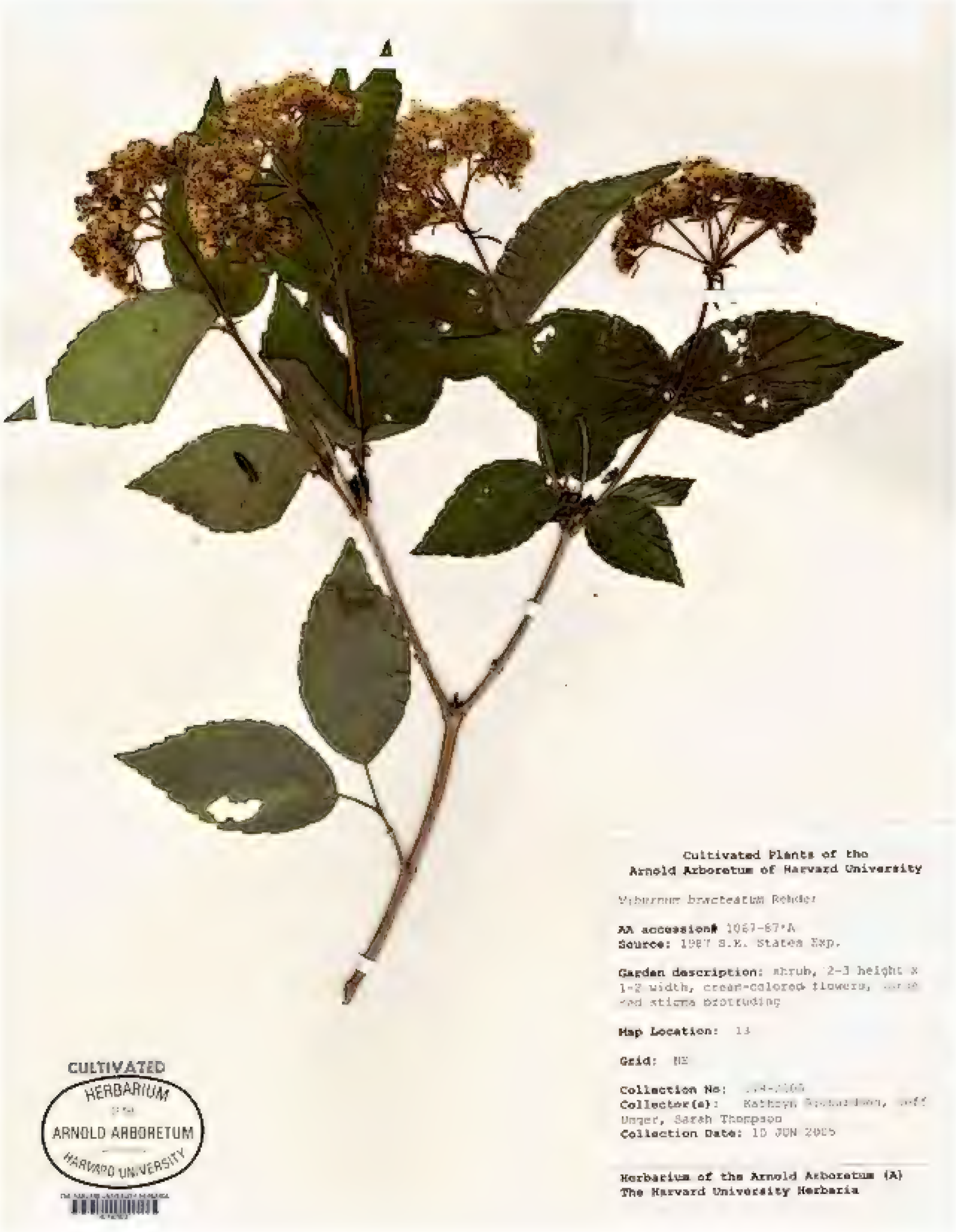
PROPAGATION: Softwood or greenwood cuttings, 5,000ppm k-IBA



Site 14 Turkey Creek, near Winchester Tn.
CPC Viburnum bractectum - 3 plants
Arundinaria (?) sp. - 1 plant

Site 15 Coosa River, near Rome GA.
CPC Viburnum bracteatum - 3 plants -
Ilex sp. (deciduous probably longipes)
Carya ovata

Site 16 Titus Ga. (a Cladrastis site record
Spirea sp. (possibly virginiana)
Kalmia latifolia
Ilex sp. (deciduous)
Hypericum sp.
Lilium sp.



Cultivated Plants of the
Arnold Arboretum of Harvard University

Viburnum bracteatum Rehder

AA accession# 1067-87*A
Source: 1987 S.E. States Exp.

Garden description: shrub, 2-3 height x 1-2 width, cream-colored flowers, [illegible] red stigma protruding

Map Location: 13

Grid: NE

Collection No: [illegible]-2005
Collector(s): Kathryn [illegible], Jeff Unger, Sarah Thompson
Collection Date: 10 JUN 2005

Herbarium of the Arnold Arboretum (A)
The Harvard University Herbaria

Above: Arnold Arboretum assistant plant propagator Rob Nicholson's field notes from the 1987 Southeast States Expedition. The first *Viburnum bracteatum* acquisition at the top of the page (Site 14 from Turkey Creek) is the plant that is being introduced as 'Crimson Gem'.

Left: Arboretum herbarium voucher of original division (1067-87*A) in 2005. Note the dried, dark red floret (mislabeled "stigma") barely visible in the center of the inflorescence on the left.

at each node (junction of leaf petiole and stem), as well as the two bracts below each inflorescence. Paired with leaf colors ranging bronze to maroon, the clusters of shiny oval to rounded fruits (drupes) are blue-black at maturity, providing autumn interest.

'Crimson Gem' was originally acquired as part of the Arboretum's commitment to plant conservation. The Arboretum is a participating member of the Center for Plant Conservation (CPC), and has holdings of ten current indigenous North American species on the CPC threatened plant list. Founded in 1984 at the Arboretum, and with the national headquarters currently at the San Diego Zoo Safari Park in Escondido, California, CPC is unique partnership of conservationist organizations, such as botanical gardens and arboreta. Its aim is to preserve threatened North American plant taxa by *ex situ* conservation focused on acquisition and species stewardship.

Bracted viburnum is considered critically imperiled (global conservation status G1) and is endangered in the wild—mainly due to limestone quarrying, but also by clearing and logging operations. Only a few populations remain in the southeastern states of Alabama, Georgia, and Tennessee. In its current range, it is found selectively as an understory shrub growing in open deciduous woodlands and along rivers, particularly on the ledges of the Coosa River, which begins in Rome, Georgia before entering Alabama, and on the escarpment of the Cumberland Plateau (southern part of the Appalachian Mountain Plateau).

With CPC collections at the forefront of Arboretum institutional priorities in the mid-1980s, assistant plant propagator Rob Nicholson embarked on multiple expeditions to facilitate *ex situ* conservation. "I basically would go to the herbarium, compile a list of locales for the targeted species, and off I went," Nicholson recalls. "Once in awhile I would connect with a botanist who knew a species and where to find it ... but it was mostly solo hunting." (Nicholson was a prolific collector for the Arnold and other institutions; see his account of the expedition to collect *Pinus krempfii* beginning on page 32.)

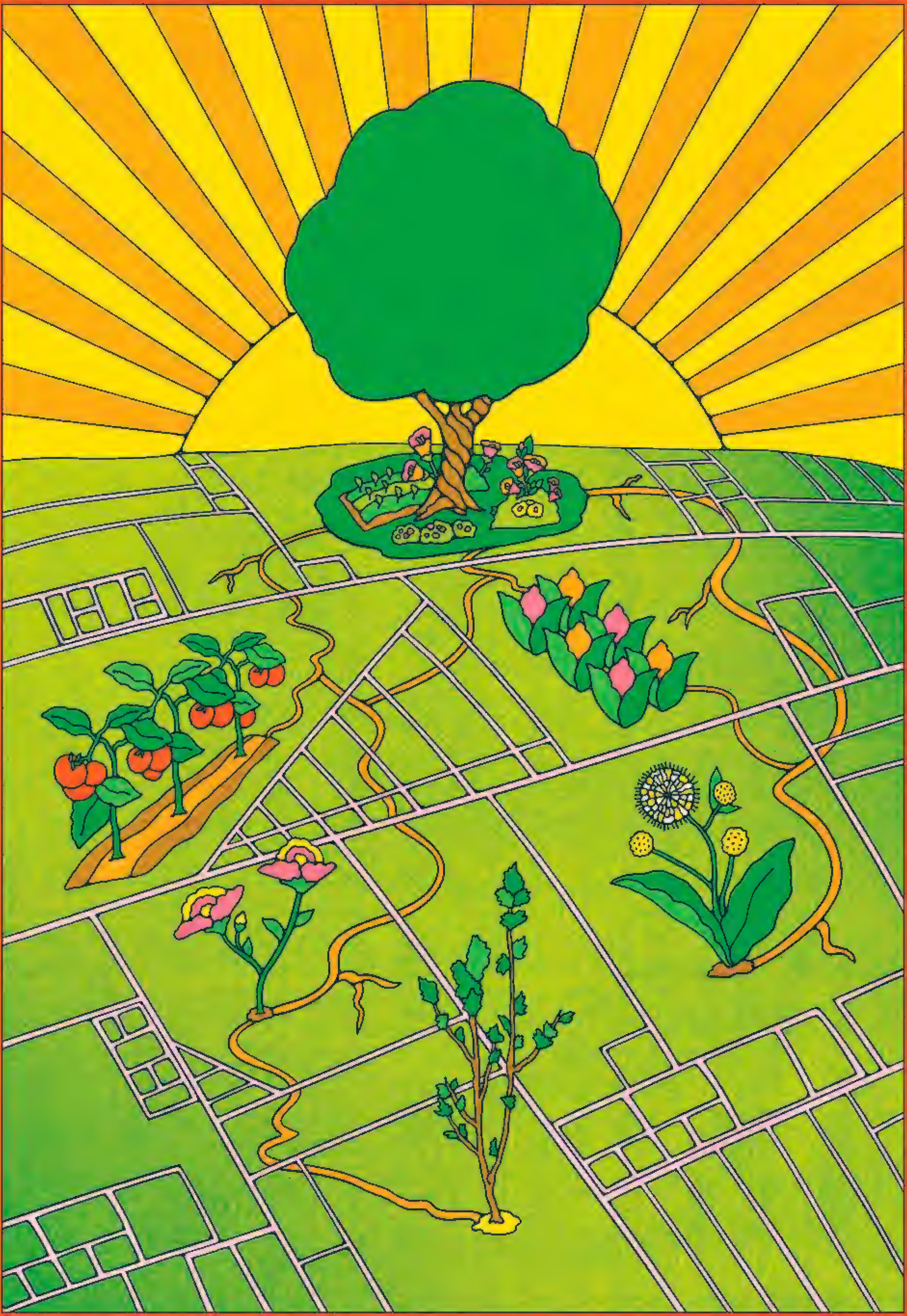
Nicholson's investigations led him to travel to Tennessee and Georgia in October 1987, where scarce native populations of bracted viburnum are present. Twenty-one acquisitions from the very full week-long Southeast State Expedition were accessioned. The trip was characterized by "long 16-hour days ... and long miles." Other taxa of interest on the trip included Fraser fir (*Abies fraseri*), endangered due to the balsam wooly adelgid; southern bush honeysuckle (*Diervilla sessilifolia*), considered threatened in its native state of Tennessee; and longstalk holly (*Ilex collina*), vulnerable with only 4,000 individuals in the wild.

With so many target taxa acquired, Nicholson's CPC expedition was a success, but not to the extent that he could ever have imagined. Nicholson found the 'Crimson Gem' parent plant growing in Franklin County, Tennessee. Flowering in late spring, this bracted viburnum's precious bloom could not have been observed when Nicholson made the collection on October 10th. Though it was in its fall fruiting phase, he recalls that no fruit was present, so he harvested a division—the sole means of preserving this crucial imperiled taxon. To hedge his bet, Nicholson took three divisions, two of which remain in the collections. Three days later, Nicholson visited Floyd County, Georgia, and collected other bracted viburnum divisions on the bluffs overlooking the Coosa River. These are also planted in the living collections, but don't share their relatives' unusual attribute.

Bracted viburnum divisions were cataloged upon receipt at the Arboretum, and 'Crimson Gem' was given the accession number of 1067-87. Plants were dutifully nurtured at the Dana Greenhouses at the Arboretum, and then aptly planted at the Viburnum Collection/Greenhouse border (likely so Nicholson could keep tabs on his valuable acquisition accomplishment) in 1992. In 2005, stem cuttings were taken of this endangered (and extraordinary) plant to increase the Arboretum's *ex situ* holdings. The resulting clone, with the same ruby "gem," was planted in the Leventritt Shrub and Vine Garden.

With over thirty years in the Arboretum landscape, 'Crimson Gem' has stood the test of time. It has provided outstanding seasonal interest, and has been reliable year after year in a shrub border. It would also be well utilized if planted as a hedge, or in mass. 'Crimson Gem' is adaptable to different soil conditions—it has certainly tolerated the Arboretum's acidic soils just fine, though it is native to the alkaline soil of limestone woods. 'Crimson Gem' cuttings were just provided to nursery partners, so it will be several years before this new cultivar is available in the trade. However, it will no doubt be the jewel of gardens someday, and we can all have that magical "aha" moment—flowers have red centers!

TIFFANY ENZENBACHER *is Head of Plant Production at the Arnold Arboretum.*



Propagations

GREEN CITIES

Public Gardens and the Livable City

By Donald A. Rakow, Megan Z. Gough, and Sharon A. Lee

Over the centuries, public gardens like the Arnold Arboretum have welcomed visitors to their grounds and enhanced those visits with opportunities to learn about the garden's plant collections and landscapes and to reflect and relax. In recent decades, many gardens have expanded the garden experience through art exhibits and performances of musical and theatrical groups on the grounds.

However, most visitors to public gardens are those with the means to travel to the garden and the resources to pay for admission, when a gate fee is charged. For residents of underserved neighborhoods, even public gardens that offer free admission may be largely unknown due to a lack of public transportation, the absence of bilingual signs, or a perception of the institution as unwelcoming and catering only to higher-income or white members of the community.

To thrive in the twenty-first century, public gardens must respond to their elitist reputations and invest in programs and policies that are inclusive, caring, and relevant to a wider audience. No matter their size or budget, it is time for public gardens to assume their responsibilities as community institutions and to focus on outreach to all community residents. As plant-based scientific and educational institutions, public gardens have the expertise and the experience that can help address challenges such as unsafe neighborhoods, poor quality science education, limited access to fresh and healthy foods, a lack of job training and job opportunities, and degraded environments.

In support of the role that gardens can play in addressing these challenges, studies have shown that as streetscapes become greener, they attract more activity and engender more pride in public spaces. When young children are provided with hands-on science and nature instruction, they are more likely to succeed in school and see science as a possible career alternative. When previously incarcerated individuals are given training and offered jobs in the green industries, they are far less likely to return to prison. And when under-resourced residents are given the tools to build and grow community gardens, their diets and health also improve.

The most successful initiatives arise through partnerships. As we demonstrate in our book, *Public Gardens and Livable Cities* (Cornell 2020, foreword by Scott Medbury), many initiatives to improve quality of life in our cities result from partnerships between gardens and other community organizations, neighborhood groups, municipal agencies, and private entities. There are a number of reasons why such partnerships make sense for public gardens. First, to be accessible to an increasingly diverse population, many programs need to be based where people reside or gather, rather than at the gardens themselves. Also, addressing environmental hazards in our poorest neighborhoods and connecting people with plants supports the priority that many public gardens now place on environmental stewardship. Through collaborations, gardens can be invaluable to initiatives that involve urban greening, while their partners contribute social capital and other organizational, financial, or logistical aspects.

Illustration by Kate Dehler

Public gardens can learn from organizations that have already entered into partnerships that resulted in successful initiatives. Our book provides multiple examples of partnerships that gardens have formed with school districts, municipal governments, community foundations, businesses, and neighborhood associations. Some of those partnerships are described below. In each example, partners have brought their particular strengths to the project, with the result that together they have had a far greater impact than any could have produced on their own.

Community impact is possible across a variety of sectors, including public safety, food security, educational quality, and economic development:

Prizes awarded to the “greenest blocks” serve as points of pride for residents.

Promoting Neighborhood Safety and Well-Being

Many underserved neighborhoods are still feeling the effects of the federally supported redlining initiated in the 1930s. Unequal access to mortgages, inadequate park development, and absence of street tree plantings are all manifestations of how discriminatory housing policies still impact low income and communities of color. To provide all communities within their borough with opportunities to reverse these trends, Brooklyn Botanic Garden created the Greenest Block in Brooklyn contest in partnership with multiple local block and civic associations, the Brooklyn Borough President’s office, and engaged funders. The residents who plant and beautify their individual streets are not only improving the environmental quality of their surroundings, they are also building social ties, enabling them to better address neighborhood concerns related to crime prevention, economic development, and other quality of life issues. The prizes awarded to the “greenest blocks” also serve as points of pride for residents, encouraging them to sustain their beautification efforts in subsequent years.

Access to Healthy Foods and Promoting Healthy Lives

Underinvestment also strikes poor urban communities in the paucity of food choices. Neighborhoods that lack access to a full range of grocery items, especially fresh fruits and vegetables, have been termed “food deserts” and are often associated with high rates of obesity, high blood pressure, and diabetes, health issues that take a toll on our medical system.

To address the negative impacts of food deserts throughout the Bronx, the New York Botanical Garden (NYBG) created Bronx Green-Up, a program that annually supports up to 75 community gardens and urban farms throughout the borough. While NYBG provides horticultural expertise and planting supplies to each growing site, the program’s continued success depends on a range of local nonprofit and educational partners. Among these are Farm School NYC, NYC Parks Green Thumb, Butterfly Project NYC, and the Bronx Land Trust. Through its hands-on engagement with communities, NYBG, which was once seen as an elite institution, now feels like a welcoming space for many more of its neighbors.

Training and Employment Programs

Throughout our metropolitan regions, prisons are overcrowded, and sentencing is often long delayed. Many incarcerated individuals are likely to return to their past behavior, resulting in a continued cycle of recidivism. Some public gardens in partnership with other community institutions have created initiatives to help break this cycle, especially for non-violent offenders. Programs such as Roots to Re-Entry (R2R), administered by the Pennsylvania Horticultural Society, treat young incarcerated men as individuals, rather than statistics. The R2R program depends on partnerships with the Bureau of Prisons, the District Attorney’s Office, the Defender’s Association of Philadelphia, and a web of local landscaping businesses and foundations. This synergy of participants allows the R2R program to train participants in horticultural and mechanical skills, and then helps to place them in green industry positions. Moving these young men into paying positions is enhanced by mentors who assist them as they re-enter the world. As a result, the recidivism rates for R2R participants is 30 percent compared to 65 percent for the general prison population in Philadelphia.

> Through its hands-on engagement with communities, NYBG, which was once seen as an elite institution, now feels like a welcoming space for many more of its neighbors.

Improving the Quality of Science Education

Science education in U.S. public schools suffers from too little time devoted to the subject, a shortage of trained science teachers, and traditional curricula that focus on memorization rather than engaging students in interactive instruction. In many urban school districts, a high proportion of students also suffer from the negative impacts of poverty. These shortcomings come as the nation deals with the consequences of global climate change, loss of biodiversity, and polluted environments.

The Chicago Botanic Garden (CBG) is addressing these challenges through their multi-stage Science Career Continuum. The initial stage, Science First, is an intensive, inquiry-based summer program designed to introduce middle schoolers to basic biological principles and applications. At the Garden, students are led by a team of public school science teachers and CBG staff in scientific inquiry, investigations, and observations. Those who excel are invited to participate in the College First program for eleventh and twelfth-grade that features a summer-long intensive immersion program at the Garden, including an environmental science practicum, an internship with a CBG scientist, and a monthly session with CBG staff mentors during the school year. Chicago Botanic Garden partners with a range of educational and social services organizations in the execution of these programs, including Northwestern University, City Colleges of Chicago, Chicago Scholars, Chicago Public Schools, and Hive Chicago, a network of nonprofits dedicated to connected learning. The impact of this continuum of programs is stunning: 100 percent of College First participants have graduated from high school, and 94 percent matriculated to two- or four-year colleges.

These hardly exhaust the examples—or the possibilities. The partnerships mentioned in this article and others described in more depth in *Public Gardens and Livable Cities,* will not, by themselves, solve all of the challenges of our cities. But such efforts are making a difference in creating cities that more livable for all residents. They succeed because they involve the collective expertise of both the gardens and their partners; they address real issues as identified by community members; and they reach out broadly to engage partners from across the municipal, not-for-profit, and business worlds. To learn about additional exciting collaborations between public gardens and their partners , visit our companion website at https://blogs.cornell.edu/pglc.

Donald A. Rakow, Megan Z. Gough, and Sharon A. Lee are the authors of *Public Gardens and Livable Cities: Partnerships Connecting People, Plants, and Place* (Cornell 2020).

SMALL WORLD

Plants, Identity, and War in Ukraine

By Brendan Keegan

From 2010–2012, I served as a U.S. Peace Corps Volunteer in a small Ukrainian town. In 2017, my wife (who also served in Ukraine) and I returned for a visit. We met with Natalia, a dear friend, and former colleague, at the school were I once worked. Together, we walked the old paths connecting nearby villages through the surrounding forest. It was a crisp, September day. The previous year's leaves, from towering old lindens, crunched beneath our feet.

As we walked, I remembered the forest in seasons past. In March and April, millions of blooming white wood anemone and snow drops carpet the understory as far as the eye can see. A neighboring *baba* (granny) once asked if I would pick her a bouquet of those fragile, ephemeral flowers. As a child, she had plucked from those same woods. Giving them as gifts is a tradition common in the region for good luck and health.

Last spring, I observed Arboretum visitors marveling at the same delicate snowdrops popping throughout our own collections. I thought of that friendly *baba*. As news images show the utter destruction of Ukrainian cities, towns, and villages, I often think of her, long since deceased, and her love for those simple flowers.

Many readers will surely appreciate the Ukrainian custom of sharing snowdrops, of marking the seasons with walks through old forests. Indeed, Ukrainian identity as a whole is

Illustration by Tania Yakunova

strongly associated with the natural world, and with plants in particular. The *kalyna*, better known in the U.S. as a guelder rose or snowball viburnum, is the most prominent example. Ukrainians believe planting one outside a home brings health and good fortune. Its red berries also serve as a metaphor for Ukrainian nationhood and independence. The plant prominently features in Ukrainian music, literature, and art. Its red berries adorn the bright embroidery of the *vyshyvanka* (Ukraine's national costume) as well as the modern-day insignia of Ukraine's armed forces.

Plants play important roles in many other aspects of the culture. Wheat, the nation's economic lifeblood, is famously referenced in Ukraine's flag, golden under a bright blue summer sky. European aspen, found at the Arboretum on Peters Hill, features widely in Ukrainian poetry and literature, especially in the work of Ukraine's national poet, Taras Shevchenko. In Kyiv, Ukraine's capital, horse chestnuts adorn the various squares; at one point in its history, horse-chestnut leaves even graced this green city's official seal.

Botanically inclined readers might even be envious of Ukraine's calendar, in which the names of months reference coinciding natural phenomena. For example, *Berezen'* (March) means "birch," and indicates the time to tap the birches for their sweet sap. *Kviten'* (April) is "flower," when the earliest blooms appear. *Lypen'* (July) is "linden," marking the long summer evenings when this tree's sweet aroma bathes Ukrainian towns. My personal favorites mark the fall. *Zhovten'* (October) means "yellowing," referring of course to changing leaves, while *Lystopad* (November) translates literally as "leaf fall." Examples such as these abound in Ukrainian culture.

In addition to sharing a general love for plants, the Arnold Arboretum also shares connections with Ukrainian botanical gardens and their staff. During the first year of the pandemic, our virtual lectures and educational presentations provided an opportunity for a truly global audience to attend and participate. Staff from Ukraine's M. M. Hyrshko National Botanic Garden in Kyiv were among them. After communicating first over social media, then directly, they sought advice from Arboretum staff on plant curation and exchanges.

Of course, everything changed for our Ukrainian horticultural counterparts when Russia invaded on February 24, 2022. As the Russians advanced towards Kyiv, the M. M. Hryshko National Botanic Garden closed to all visitors. While many Kyivites fled the city in the face of bombardment, Arnold Arboretum staff kept in touch with our garden connections who remained.

Throughout the months of fighting, horticulturist Olga Pokhlychenko updated us on the situation in city and garden alike. As many a gardener can surely relate, she feared for her plants as well as her colleagues, friends, and family. Of course, she was not alone; a select group of staff were allowed into the garden to keep their treasured greenhouses functioning during the bitter February cold.

When the garden closed, Olga joined multitudes of other citizens volunteering in defense of their city and for each other. She spent much of her time gathering and dispersing medical supplies, and later served as a volunteer coordinator. At one point, she darkly joked that she had so many medical supplies in her house that she had retired as a horticulturist and become a pharmacist instead.

When the Russians retreated from Kyiv in late March, Olga and others went to assist civilians living in the formerly occupied suburban towns and villages. Several towns, including Bucha and Irpin, were off limits as a result of mines and booby traps left behind. However, in the numerous surrounding villages, they delivered aid to the disproportionate number of elderly who remained during the fighting. Some volunteer aid deliveries included seeds for vegetable gardening, a popular pastime and food source for both urban and rural Ukrainians even before the war.

Even after the Russian withdrawal, the danger of attack remained so high within Kyiv that the M. M. Hyrshko National

Brendan Keegan is a horticulturist at the Arnold Arboretum.

Ukrainian identity as a whole is strongly associated with the natural world, and with plants in particular.

Botanic Garden stayed closed for several months. As winter turned to spring, many loyal visitors mourned the inability to see their beloved plants. They inquired about the status of their favorite magnolias, cornelian cherries, and forsythia. Unfortunately, even the garden's renowned lilac festival was canceled for security concerns.

Finally, after being closed for over ninety days, the M. M. Hyrshko National Botanic Garden reopened for staff and visitors on May 28. The opening day aligned with the weekend-long celebration of Kyiv's city day, marking its 1,540th anniversary. Olga, and those of her colleagues who remained in Kyiv, finally returned to their plants.

At the Arnold Arboretum, our own Lilac Sunday returned in full after two years of muted festivities. In tribute to our Ukrainian colleagues, we highlighted a rare lilac cultivar in our collection, *Syringa vulgaris* 'Ukraina' (pronounced oo-kray-EE-na), named in honor of Ukraine. Although still a small plant, our *Syringa vulgaris* "Ukraina" bloomed beautifully this year.

The cultivar was discovered in 1974 by Ukrainian horticulturist Valentina Zhogoleva. She worked at what is today Ukraine's National Botanic Garden, where Olga and her colleagues continue her care for the lilac collection. A woman in a field largely dominated by men, Valentina is also credited as a collaborator on many lilac cultivars. All of her credited lilacs are named after Ukrainian heroes, cities, and literary icons. The Arboretum plans to introduce several of these now rare Ukrainian cultivars into our collections over the coming years. We also hope to share acquired specimens with Ukrainian institutions, such as Harvard's Ukrainian Research Institute, which may not already have them. Our hope is to provide plants for memorial plantings, remembering Ukrainians who have died in the ongoing war, while also preserving unique cultivars of Ukraine's botanical heritage.

In early spring, I connected again with my friend Natalia. She provided updates on the town, my colleagues, and both the strain and unusual rhythm of war. As a teacher, she described the difficulties of conducting lessons with periodic intermissions in the bomb cellar. Like many of us, she found solace working outside. "(L)ife finds its balance even during war," she wrote in her message. "We also have spring here—it is still cold, but tulips have already blossomed, we have a lot of fruit trees, so I have enough work to do.... And a rose flower garden of 52 rose bushes. My hands are all in thorns—but it's not so bad. The beauty of flowers is worth it."

I am sure that many readers would sympathize with Natalia's words. Perhaps peace is like Natalia's roses, painfully, and painstakingly, cultivated. Until it is achieved, I hope the shared love of plants, such as the beautiful snowdrops in spring, the flowers of our Ukrainian lilac in May, and the red berries of the *kalyna* each fall, remain symbols of personal and institutional connection with the Ukrainian people.

PERSONAL HISTORY

Among white pines, at the foot of them

By Éireann Lorsung

The largest city in the place I call Maine is called Portland, and it lies along the Atlantic coast in the northeast of the country called the United States. For as long as the city has existed its industries have been tied to the sea: fishing, lobstering, clamming, oystering, seaweed-picking—though that is changing: wealth clusters along the seafront and the city's industry turns toward tourism. At low tide the horizon goes even further out than you'd think possible, and between the expensive houses and the drawn-back water, the seaweed pickers go, bent over, along the little strip of land that belongs to everyone. The coastline just north of the city becomes rocky, and small granite islands house wealthy summer residents and year-round island people who know the ferry schedule by heart.

A map eye and a surveyor's eye, a deed eye; an insurance company's eye, a property investor's eye, a painter's eye; an art collector's eye beholding the paintings of the "empty" landscape that hang in the well-appointed houses in the best neighborhoods, in the white cool rooms of the city's art museum. We perceive the beauty of a map or painting in the manageable space between the object and ourselves, the gaze a place that holds the object still. In the map and the landscape painting—objects I feel such a fondness for—the place that holds me is reduced to a place that I can hold. It becomes property and I am its arranger.

The world goes on around the museum and the city records office, in infinite overlapping circles. The room and the building, the city and the state, are permeated by economies and public-health statuses and modes of transit and pollution, by taste and custom and the determining structures of US racial and class hierarchies. We work temporary jobs in Portland and pay two-thirds of our income to the landlord. It is a pandemic, so we don't go anywhere. We couldn't afford to go out in this city in any case. To occupy my time and thoughts, I take walks and ride my bicycle: watching the light change is free, noting down the seasonal appearance of weeds in the cracks is free. I am moving through a landscape that is unfamiliar to me, and I cannot see it from outside—outside the drafty, unheated apartment, outside the exorbitant rent, outside the virus transmitted by breath. Nor from outside the sea air, the smell of the white pines, the sting of first snow on a stiff breeze. Only from inside, where I am: with you.

I find my way, in copper October, along a causeway to an island that houses the state school for Deaf and Blind students, a cemetery where the dogs and horses of a former governor have long since turned into soil themselves, and a clearing in which visitors build structures out of twigs, leaves, shells, seaweed, rocks, pinecones, and a winking belief in fairies. (The children who visit to see the fairy village do not wink, and their houses are furnished with bright orange berries, mushrooms, moss carpets, colorful and smooth stones, the best shells.) The name I know for this island is Mackworth.

Among the trees, the name I know falls away, insubstantial as a piece of Scotch tape. Its granite edges, its carpet of rust-orange pine needles, its non-local roses trimmed back by state park service employees, its sumac, its dulse. I have names for these, and yet the names cannot hold them. They exceed my ability to call them.

In every season, the island's white pines establish the architecture of my passage there. I walk the circumference in autumn's fullness, then in the silence of winter as the wind stirs the ocean into gray slush, and in spring as a bright yellow haze passes through the deciduous trees of the understory. And in the summer, in the rich quick bright unbearable green of living things that know how soon they will be dying.

The tall gray bodies of the pines set a rhythm for seeing. Their needles form paths and fields among the trees. The sunlight falling through them, I receive. The sky they orchestrate among their openings.

A gate and a field, or White pines and fog, or Look up and keep counting, or Thinking of the ocean from the middle of the continent. *Art by Éireann Lorsung*

They are an uncapturable color, a green that is not singular *green* but green-prismatic with all earth colors: chlorophyll, umber, ochre, iron oxide. Light and vision refracting in air. Among the white pines, at the foot of them, I find a distinct understanding of my proper proportion. The placedness that makes me *among* and *with* and makes my gaze *through* and *in* rather than *at*. From the edge of the city I see them, objects on a horizon: but among them, my sight is transformed and I am a subject among subjects. I would like to hold them in this *with*ness and *through*ness.

"Landscape" is an effect of an exterior position. I am wrestling with my love of landscape painting and my position as an outsider to that tradition, by virtue of gender, training, and class—and I am wrestling with the fact of my being-settler in this place, with the history of ownership-as-land-relation I belong to. From a distance, the painter or surveyor perceives an interplay of light, shadow, form, movement. These are arranged as *painting* or as *map,* or, if in the mind rather than in material, as *property*. But this island is a freely offered immersion in color, perspective, time. Surrounded by white pines, it is impossible to take distance. I cannot stand back and see myself apart from them. They remind me *we have always been involved in one another,* whether I knew it or not.

`Surrounded by white pines, it is impossible to take distance. I cannot stand back and see myself apart from them.`

I was formed in a scientific and religious environment where human beings and other beings are unequal. But despite how my imagination or understanding was formed, the white pines' way of being requires, structurally, that I am *among* them, *beneath* them, *between* them, *in* their *midst*. It changes the kind of relationship I can have, and not just to the white pines. The *with*ness they do to me extends limitlessly. They *with* me, and they *with* their understory. They *with* the greyness of the ground, scattered with their rust-orange needles, after long weeks without rain. They *with* the chipmunks who make holes at their feet. They *with* and are *with*ed by the non-local roses and the local ferns, the lichen, the sound of the tide arriving, the bladderwrack, the smell of the mud on a hot afternoon coming through the closer sweetness of the needles that carpet the dry ground. They *with* the conditions of the air—humidity, pollution—and of the water, weather, the salt marshes, the bogs beyond, the fields beyond that. The way the white pines *are* makes me *with,* a *with* that exceeds them and far exceeds me—and exceeds the pronoun "me". Here, among the trees, I find myself one among many, even unseen many, moving in a concert it is impossible to know in full.

The island, the ocean, the iron streaks in granite, the yellow seaweed and its scent in the September air, the red hips of the roses spattering the afternoon: I don't want a painting I can own as soon as I see, that lets me say *I know what you are.* I want something that can do to me again what has been done here—that *amongs* me. As color does to me, as scent does: *throughs* me. *Withs* me. *Bewiths* me. This human head and your lowest branches. The light held there, having fallen through you from the nearest brightest star. The air I expel from my lungs and take into my lungs. The words-failness of that light, air, open, up, around space. An experience closer to what I name *preposition* than *noun:* more than *thing* it is *movement, direction, location,* a totality of space and passage.

The pines make this sense as they move through time and space. By the time I arrive where they are, they have ordained an entire way of being, and I enter it. This is true of almost all places I go: the city and its apartments, the museum and its rooms. They have been made in advance and they will outlast me. Among the white pines on this rocky island I am altered to fit the time and space *of the pines*. What is this alteration? It changes the I that I am, and the eyes that I have. The duringness and withinity of the pines are a grammar that refits me to an accompanied and accompanying multiple subjecthood. No longer the center of the sentence-shaped universe or the distant viewer of a landscape made to hold, I am here: with the pines, with the world they are.

Éireann Lorsung is a 2016 NEA Fellow and author most recently of *The Century* (Milkweed Editions, 2020); she teaches in the Creative Writing Programme at University College Dublin. For more information, visit https://obhara.com.

Hardwood Cuttings

By Sean Halloran,
Plant Propagator

Plant propagation is both traditional art and applied science. Made from mature, dormant stems, hardwood cuttings are just one clonal propagation technique we use at the Arnold Arboretum to coax life from some of our most valuable accessions. In New England, we can root hemlock and many other genera via this technique. We collect hardwood material in late fall or early winter after plants enter dormancy and deciduous plants have lost their leaves, selecting younger, healthy stock for optimal results. Hormone is applied to the freshly prepared cuttings, which are usually "stuck" the same day they are collected, in benches filled with quick-draining growing media, tented with plastic to ensure high humidity, and heated from below to encourage rooting. Hormones and wounding treatments are taxon-specific, based upon the scientific literature as well as our own propagation records. Cuttings that survive and root will be potted up in the spring or early summer, eventually to serve as prized members of the next generation of our collections.

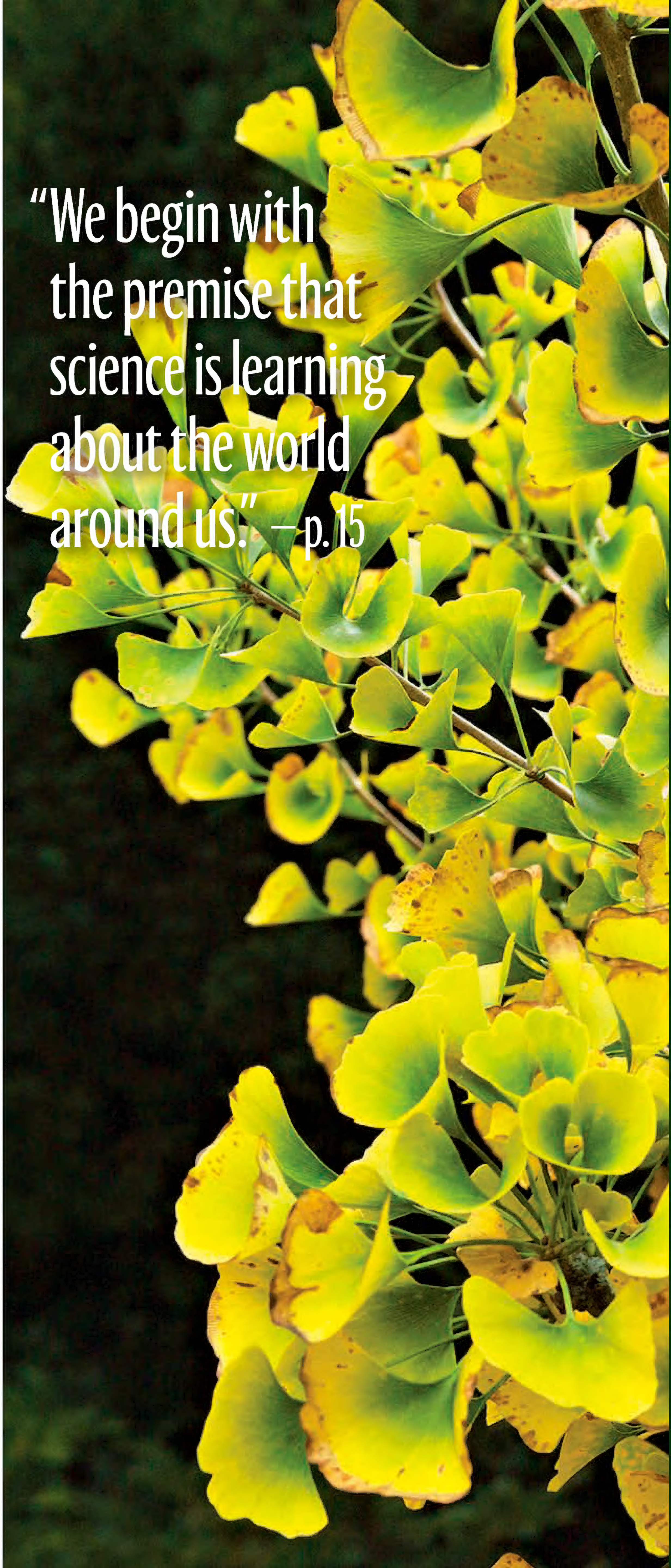
15-100

Number of cuttings collected per accession.

172

Accessions in the collections being actively propagated.

Hardwood cuttings of hemlock, originally collected by Peter Del Tredici. *Photograph by Sean Halloran*



"We begin with the premise that science is learning about the world around us." — p. 15

The ARNOLD ARBORETUM *of* HARVARD UNIVERSITY

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